







**BINDING LIST OCT 15 1923.**



*M.D.*

# ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

EDITED BY  
LEWIS STEPHEN PILCHER, M.D., LL.D.,  
OF NEW YORK

WITH THE COLLABORATION OF

SIR WILLIAM MACEWEN, M.D., LL.D.,  
OF GLASGOW,  
Professor of Surgery in the University  
of Glasgow.

W. H. CLAYTON GREENE, F.R.C.S.  
OF LONDON,

VOLUME LXXVII  
JANUARY—JUNE 1923

PHILADELPHIA  
J. B. LIPPINCOTT COMPANY  
1923

1956/5-  
20.11.23

COPYRIGHT BY  
J. B. LIPPINCOTT COMPANY  
1923

## CONTRIBUTORS TO VOLUME LXXVII

ABELL, IRVIN, Louisville, Ky.  
ARCHIBALD, EDWARD, Montreal, Canada.  
BAKER, JAMES N., Montgomery, Ala.  
BARTLETT, WILLARD, St. Louis, Mo.  
BEER, EDWIN, New York, N. Y.  
BERG, BENJAMIN N., New York, N. Y.  
BIDGOOD, CHARLES Y., Cincinnati, Ohio.  
BLAIR, VILRAY P., St. Louis, Mo.  
BLOODGOOD, JOSEPH COLT, Baltimore, Md.  
BOLAND, FRANK K., Atlanta, Ga.  
BROWN, HENRY P., JR., Philadelphia, Pa.  
BURDICK, CARL G., New York, N. Y.  
CALLANDER, C. LATIMER, San Francisco, Cal.  
CARTER, BURR N., Cincinnati, Ohio.  
CHARLTON, PAUL H., Columbus, Ohio.  
COLE, WILLIAM, Anaheim, Cal.  
CONNORS, JOHN F., New York, N. Y.  
COPHER, GLOVER H., St. Louis, Mo.  
CRAIG, WINCHELL McK., Rochester, Minn.  
DAVID, VERNON C., Chicago, Ill.  
DAVIS, JOHN STAIGE, Baltimore, Md.  
DECOURCY, JOSEPH L., Cincinnati, Ohio.  
DOUGLAS, BEVERLY, New Haven, Conn.  
DOUGLAS, JOHN, New York, N. Y.  
DOWD, CHARLES N., New York, N. Y.  
DRENNEN, EARLE, Birmingham, Ala.  
EGGERS, CARL, New York, N. Y.  
EISENDRATH, D. N., Chicago, Ill.  
ELKIN, DAN COLLIER, Boston, Mass.  
ERDMAN, SEWARD, New York, N. Y.  
FARR, CHARLES E., New York, N. Y.  
FREEMAN, LEONARD, Denver, Colo.  
GEISINGER, JOSEPH F., Richmond, Va.  
GIBSON, ALEXANDER, Winnipeg, Canada.  
GRAHAM, DOUGLAS, Boston, Mass.  
HALLAHAN, ROBERT E., Buenos Aires, Argentina.  
HARVEY, SAMUEL CLARK, New Haven, Conn.  
HELSLEY, GORDON F., Fresno, Cal.  
ILLOWAY, HENRY, New York, N. Y.  
JACKSON, CHEVALIER, Philadelphia, Pa.  
JONES, JOHN F. X., Philadelphia, Pa.  
JOPSON, JOHN H., Philadelphia, Pa.  
JUDD, E. STARR, Rochester, Minn.  
KEILLER, V. H., Galveston, Texas.  
KELLOGG, EDWARD LELAND, New York, N. Y.  
KEYES, A. BELCHAM, Chicago, Ill.  
KEYSER, LINWOOD D., Rochester, Minn.



## CONTRIBUTORS TO VOLUME LXXVII

KLEINBERG, S., New York, N. Y.  
LAMSON, OTIS F., Seattle, Wash.  
LEHMAN, EDWIN P., St. Louis, Mo.  
LUDINGTON, NELSON AMOS, New Haven, Conn.  
LYONS, JOHN H., Rochester, Minn.  
MACCARTY, WM. CARPENTER, Rochester, Minn.  
MASLAND, HARVEY C., Philadelphia, Pa.  
MANN, FRANK C., Rochester, Minn.  
MAURY, JOHN M., Memphis, Tenn.  
MAYO, CHARLES H., Rochester, Minn.  
McGLANNAN, ALEXIUS, Baltimore, Md.  
McIVER, MONROE ANDERSON, Boston, Mass.  
MITCHELL, JAMES F., Washington, D. C.  
MULLER, GEORGE P., Philadelphia, Pa.  
O'CONOR, SIR JOHN, Buenos Aires, Argentina.  
O'DAY, J. CHRISTOPHER, Honolulu, Hawaii.  
PARHAM, DUNCAN, Rochester, Minn.  
PENNINGTON, J. RAWSON, Chicago, Ill.  
PETERSON, EDWARD W., New York, N. Y.  
PFEIFFER, DAMON B., Philadelphia, Pa.  
PHIFER, CHARLES HERBERT, Chicago, Ill.  
PILCHER, JAMES T., Brooklyn, N. Y.  
PRATT, GEORGE P., Omaha, Neb.  
PRIMROSE, ALEXANDER, Toronto, Ontario.  
REEL, PHILIP J., Columbus, Ohio.  
RIXFORD, EMMET, San Francisco, Cal.  
ROBINS, CHARLES R., Richmond, Va.  
ROBINSON, WILLIAM T., New York, N. Y.  
SAYAD, WILLIAM Y., New Haven, Conn.  
SCHLAEPFER, KARL, Baltimore, Md.  
SCHLEY, WINFIELD SCOTT, New York, N. Y.  
SIRIS, IRWIN E., Brooklyn, N. Y.  
SORESI, ANGELO L., New York, N. Y.  
STONE, HARVEY B., Baltimore, Md.  
SUTTON, IRWIN C., Anaheim, Cal.  
TEES, FREDERICK J., Montreal, Canada.  
THOMPSON, JAMES E., Galveston, Texas.  
THOREK, MAX, Chicago, Ill.  
TORRANCE, GASTON, Birmingham, Ala.  
VILLARS, HORACE S., Washington, D. C.  
WARE, MARTIN W., New York, N. Y.  
WHITMAN, ROYAL, New York, N. Y.  
WILENSKY, ABRAHAM O., New York, N. Y.  
WILLIAMSON, CARL S., Rochester, Minn.  
WINSLOW, NATHAN, Baltimore, Md.  
ZAAIJER, J. H., Leiden, Holland.  
ZADEK, ISADORE, St. Louis, Mo.

# ANNALS *of* SURGERY

VOL. LXXVII

JANUARY, 1923

No. 1

## CANCER OF THE LARYNX

IS IT PRECEDED BY A RECOGNIZABLE PRECANCEROUS CONDITION?

BY CHEVALIER JACKSON, M.D.  
OF PHILADELPHIA, PA.

THIS paper deals with the larynx only, and that but briefly. Its length would be increased to ponderous proportions if it were expanded to include even mere mention of the important corroborative examples of precancerous conditions in other regions of the body, even if the author had the ability and the time. The reader is referred to the masterful collection and analysis of pathological and clinical data on the subject by my colleague, Dr. W. M. L. Coplin.<sup>1</sup>

Fully recognizing the etymological and scientific faultiness of the word "precancerous," nevertheless it seems necessary to use it even if we must concede it a place little better than the algebraic "X." Disclaiming any attempt to maintain a brief for the word itself the author's clinical experience with cancer of the larynx leads him to the conclusion that cancer rarely if ever appears in the previously perfectly normal larynx. The chief objection to the term "precancerous" is that it will be loosely applied without a true anatomic basis, hence it is unscientific; but if it supplies the need for a word that will contribute to the education of the profession and the laity to the undoubted clinical fact that there is a class of morbid conditions in the larynx the cure of which will diminish the incidence of cancer, the use of the word is justified until some one suggests some other single word that shall serve the same life-saving purpose.

For all clinical purposes the term "precancerous" may be defined as any histologically abnormal condition intervening between the normal and the cancerous. It will not be disputed that such a condition exists, though there is room for widely differing views as to its frequency, because of the difficulties of its determination in any given case.

Fundamental to the acceptance of the view that there is a precancerous condition is the acceptance of the view that repeated injury and long-continued irritation and inflammation are potent causes of cancer. Present limits preclude consideration here of the evidence on this subject. Any one who is unwilling to accept this view is referred to the overwhelming evidence presented and ably analyzed by Coplin.<sup>1</sup>

*Vocal Abuse as a Cause of Cancer.*—It is my belief that prolonged vocal abuse can be a factor in localizing cancer in the larynx. It seems certain

that this factor has been overlooked and does not show in statistics, because, as a rule, vocal abuse itself is in most cases overlooked. In most statistics only professional singers and speakers and street-hawkers are recognized as abusers of their larynges; whereas, as a matter of fact, they constitute but a small proportion of the persons who suffer from chronic laryngitis, papillomata, granulomata and keratoses, as the result, wholly or partially, of vocal abuse. All statistics of cancer entirely overlook the vocational abusers who are compelled to force the voice in noisy and dusty places, the colloquial abusers, etc. Another factor preventing the statistical showing of a preponderance of professional voice users among cases of laryngeal cancer, is that the irritation caused by professional use is very much lessened by proper methods of vocalization. Still another factor is that persistent vocal abuse results in such a degree of impairment of the voice that the speaker or singer retires and the irritation ceases. Out of 582 cases of proven cancer of the larynx in my experience there had been undoubted vocal abuse in 376 (64.6 per cent.). Of the remaining 206 many should be classed as having abused their larynx, but these cases were not included because of incomplete records or some other factor that prevented absolute certainty. Of the 376 approximately one-half—187—(49.8 per cent.) were professional or vocational voice users. These included not only speakers, teachers, singers, hucksters, street-hawkers, sales-persons, foremen, drill-masters, etc., but mechanics and factory employees required to talk loudly in noisy, dusty places, and persons employed in many other vocations ordinarily little suspected of requiring excessive use of the voice. The balance, 189 (50.2 per cent.) used their voices for continuous conversation. They were of what might be called a colloquial temperament. By this term is meant the numerous class of people who talk practically all the time they are awake. If no listener is available they will hunt one; if none can be found they will talk or sing to themselves. Continuous phonation with them is a nerve cell habit whose cycle is the outlet for every efferent impulse excited by their daily contact with the world. Often my secretary, attendant, nurse and assistants have noticed that these people, though under my strictest orders not to talk, would, while waiting to consult me, needlessly talk all the time in the waiting room. Many of such persons are to be found among the vocational voice users who add this abuse to the vocational abuse. One form of vocal abuse not often recognized is talking, even though not loudly, in a dusty place. When talking every person is for the time a mouth-breather. Mouth-breathing is one of the well-recognized causes of chronic laryngitis.

That vocal abuse causes cancer is too broad an assertion. But that it is one of the commonest causes of chronic laryngitis, keratoses, papillomata and granulomata, is proven by experience; and that these conditions when perpetuated by vocal abuse and other causes can be a suitable soil for the development of cancer is, in my opinion, abundantly supported by clinical observation. The etiologic effect of vocal abuse is shown by the therapeutic effect of absolute silence. In the author's experience there is no other means to

compare with absolute silence in remedial efficiency in all forms of laryngeal disease. By absolute silence is meant the writing of everything that the patient has to say, even whispering being forbidden. Laryngeal lesions of the most widely varying character, such as lues, tuberculosis, benign growths, even cancer itself, will show local improvement under a strict silence régime. That the improvement in cancer is a lessening of cellular lawlessness cannot be maintained, but that the associated congestive, inflammatory and irritative phenomena are decreased to the extent of a lessening of the stenosis, has been clinically observed in the author's cases so frequently as to admit of no doubt. The author has often seen papillomata, granulomata, small œdematous growths and other benign inflammatory tumors totally disappear under silence treatment. It is my rule to enforce silence during the period in which I am studying a new case for diagnosis. Over and over again it has happened that the improvement and shrinkage in obviously benign growths has been so great that I have, in many cases, decided not to operate, and occasionally this decision has been rewarded ultimately by the total disappearance of the growths without other measures than absolute silence.

The bearing of all this on the present subject is that if we are prepared to admit that irritation is one known cause of cancer, and that vocal abuse is one cause of laryngeal irritation, the conclusion is obvious that vocal abuse deserves consideration as a precancerous condition.

*Eversion of the Ventricle as a Precancerous Condition.*—In using this term the author feels a very justifiable doubt as to whether or not there actually is a prolapse of the mucosa of the laryngeal ventricle. In using the term he refers to those cases in which what looks like a fold of normal mucosa can be tucked back into the ventricle with a probe. In two of the author's cases of this kind he felt justified in considering the condition as precancerous. In one of these cases a man who had an eversion of the ventricle first discovered in him by Dr. John Sterret, ten years later came to me with a fungating cancer on the same side as the eversion, the cancerous lesion involving part of the everted fold and part of the corresponding ventricular band. Removal of an ample specimen, which was examined histologically by Dr. Ernest Willetts, proved the cancerous nature of the lesion.

*Lues as a Precancerous Condition.*—In twelve of the author's cases of cancer of the larynx there was a luetic lesion preceding the cancerous lesion. Of these three were superficial, two fungating, two granulomatous, five ulcerative. Of the ulcerative lesions two were known to have started as gummatous lesions. In all of the cases the luetic lesion had been present many months, and in four of the cases had been made to disappear temporarily by the administration of mercury. Besides these cases in which laryngeal luetic lesions were precancerous, in many other cases there was a luetic history, and such cases seemed to me to be of a greater degree of malignancy. I am aware of the fact that the foregoing statistics do not warrant it, nevertheless my opinion is that lues favors cancer of the larynx. A number of other laryngologists have made the same observation. Mr. Tilley<sup>2</sup> states, "I have noticed that

a large proportion of my cases of epithelioma of the larynx have previously suffered from syphilis." My colleague, Doctor Coplin,<sup>1</sup> gives a most logical explanation of the connection between lues and cancer that seems to fit particularly well the clinical observations in my cases of post-luetic cancer. He states, "my thought is that the infection bears an etiologic relation because it is manifested by a reaction of irritation and not because there is what, under other conditions, might be regarded as any specific connection, between the tubercle bacillus, the treponema, blastomycetic fungus, various diphtheroids, cocci or other organism, and the new growth. In a manner resembling, but quite clearly different, the microörganism in some way liberates one or more toxic substances which irritate, frustrate repair, and lead to a lawless cellular proliferation similar to that following the continued irritation produced by soot, tar, pitch, paraffin or other substances possessing allied possibilities, and the irritation accompanying certain animal parasites. In this connection it is interesting to note that no infective process exclusively or even largely suppurative tends to tumor formation. The cytologic reaction in purely suppurative lesions, such as abscesses, is not reparative, it is protective; repair follows, and only when repair is constantly frustrated does the tendency to neoplastic evolution become manifest."

*Keratoses and Leukoplakia of the Larynx as Precancerous Conditions.*—Leukoplakia, so commonly precancerous about the mouth, I do not remember ever to have identified in the larynx, though I have seen conditions superficially resembling it. Keratosis, on the other hand, is relatively common and almost every laryngologist has seen cases in which a condition with the gross appearances of a keratosis has ultimately proven malignant. It seems logical to suppose that some, at least, of these cases were similar at some stage to Case IV, reported below.

*Tonsillar Disease as a Cause of Cancer of the Larynx.*—The tonsil has long been recognized as the fountain-head of a majority of the cases of disease of the throat. It has not, heretofore, been accused of causing cancer of the larynx. But we all know that a focal infection in the tonsil can be the chief etiologic factor in chronic laryngitis; and if we admit, as I think we should, that chronic laryngitis can be a precancerous condition, we must admit that a diseased tonsil can be a cause of cancer. Tonsillar disease is certainly often overlooked in persons of cancerous age. In one of the author's cases he overlooked a chronic infective condition in the tonsil and the lingual lymphoid apron, that was afterward discovered by Dr. T. R. French. In commenting upon the case Doctor French made the following statement: "Since I have been occupied in investigations of diseased lymphoid tissues in the throat my attention has, a number of times, been attracted to the disappearance of small neoplasms and inflammatory thickenings after removal of material containing pathogenic bacteria. As a consequence, I have long been impressed with the possibility of cancer being due to infection."



*Benign Growths as Precancerous Conditions.*—Here we enter on a subject upon which whole books have been written on the laryngeal phases alone. Sir Felix Semon, many years ago, in his exhaustive "Collective Investigations" showed conclusively that the repeated removal of a benign growth as a clinical fact had not been demonstrated to have caused cancer. This has never since been disproven. In Semon's day, the removal of a specimen was done by the indirect or mirror method of laryngoscopy, the technical difficulties of which were so great that a greater proportion of small and unrepresentative specimens were removed than is the case by the direct methods of to-day. As Jonathan Wright has said of such specimens, they might be "not even from the growth itself" in some instances. But even to-day it is no uncommon thing for the first specimen removed to show a papillomatous, keratotic, ulcerative or granulomatous histology, to be followed later by a specimen from the same larynx showing undoubtedly cancerous processes. This does not necessarily mean, however, that the cancer has been a sequel of the other processes. Papillomata, granulomata, and keratotic lesions are of inflammatory origin and may have coexisted with the cancer in a different part of the growth at the time the first specimen was taken. Irritation and inflammation may have been the original cause of both without necessarily a sequence. Moreover, once the barrier of a normal epithelial surface is broken, mixed pyogenic infections result in inflammatory processes. The author has seen a number of instances in which a cancerous ulcerative lesion has developed in adjacent tissue villous projections that grossly and histologically resembled papillomata rather than exuberant granulations. In such cases cancer may be said to be "prepapillomatous." The etiology of benign growths is a closely related subject of which space forbids full consideration. From his experience in benign growths of the larynx the author is convinced that the chief factor in the production of laryngeal papillomata, granulomata and hæmatomata is some form of irritation, including trauma and chronic inflammation. The limits of the present paper forbid the review of the data upon which this opinion is based. But it may be mentioned that the author has seen three cases of papillomata occurring in soldiers who had been gassed and who had suffered continuously with a chronic laryngo-tracheobronchitis. Mr. Tilley<sup>2</sup> reported a case of this kind before I had seen any of the cases mentioned.

*Bearing of Location of the Lesion on Precancerous Conditions.*—All statistics show a great preponderance of squamous-cell carcinoma in malignant disease of the larynx. While it is true that metaplasia to the squamous type may and probably does occasionally occur in cylindrical and glandular-cell carcinomata, yet this metaplasia is so rare and the clinical evidence is so conclusive that all must admit that one or the other vocal cord is the most frequent site of origin in cancer of the larynx. It is an indisputable fact that of all regions in the larynx the vocal cords are the parts subjected to the most irritation in practically every human being. It is also a well-known fact that benign growths appear most frequently at the site of greatest irritation,

namely, in the central zone of the anteroposterior extent of the cord. Recent observations by Ryland<sup>3</sup> show that it is this central zone that suffers most in fatally gassed soldiers.

*Contact Cancer of the Larynx.*—The author has seen two cases in which an isolated cancerous lesion developed on one cord at a point precisely opposite an isolated cancerous lesion on the other cord, both lesions touching during phonation. In neither patient was there any continuity between the lesions. In both patients the twin foci were histologically cancerous; one case ended fatally, the other is still living after thyrochondrotomy. These isolated twin foci have been noted by other laryngologists,<sup>4</sup> and have been referred to as "contact infections." It would seem logical to class them etiologically rather as the result of mechanical irritation of the first growth on the vulnerable epithelium of the opposite cord.

*Histologic Appearances of Precancerous Conditions.*—Here we encounter difficult perhaps insurmountable difficulties. Coplin<sup>1</sup> states in effect that in the production of cancer it may be assumed that the previously normal epithelial cell must have acquired not only the ability of proliferative invasion, but the ability to transmit to new cells the same power of proliferative invasion, a power which the normal epithelial cell did not possess. If such power were present but latent, then we must assume that something occurred to rouse the power and that this power is transmitted in most instances, from the original focus. It is this power that is the intangible thing that we all know is present but as yet not materially demonstrable, that presents the greatest difficulty in the study of precancerous conditions. Coplin<sup>1</sup> states: "Every discerning student of cancer must have apprehended reactions to irritation and other cell changes preceding cancer must be potentially malignant before it is possible by means at present available to demonstrate histologically the impending malignancy; a cell or tissue must be preparing, and finally must be prepared to infiltrate before the process is manifest. . . . Naturally a cell has made necessary preparations for doing a thing before it does it; histology rarely, if ever, tells us what a cell is going to do before it does it, although many of us are constantly deluding ourselves into the belief that we can deduce the future of a cell from a study of the past or present or both. . . . Much less can one tell what a cell is going to do when neither it nor any ancestor has yet done the thing in the particular case under investigation; the fact that other cells, in other cases, similarly situated, have followed certain or uncertain courses, may be suggestive, even helpful; but offers nothing conclusively applicable to any other case." Jonathan Wright evidently had the same thought in mind when he stated that it is too much to expect a prognosis to be based entirely upon histologic examination.

#### REPORTS OF CASES

Space permits the insertion of only a few cases. I have selected four that illustrate in a marked degree certain phases that were present in greater or less degree in many others.

## CANCER OF THE LARYNX

CASE I.—A man, aged sixty-eight years, was referred by Dr. Jacob Wolf. The patient had been continuously under treatment for ten years, for progressively increasing laryngeal disease, before coming under the writer's observation. Hoarseness had been present to a greater or less extent for five years. Progressive infiltration, worse on the left side, reduced the lumen to a narrow chink. The left cord was fixed. The author did a total laryngectomy. Histologic examination by Dr. Jonathan Wright showed the growth to be an endothelioma. Recurrence ended fatally one year after operation. The case is elsewhere reported in full.<sup>8</sup> It is alluded to here because of the long duration (eleven years) of infiltrative laryngeal disease. It seems altogether improbable that the growth was endotheliomatous from the beginning. The assumption seems warranted by the statements obtained from the laryngologists who treated the patient, that he had an infiltrative laryngitis as a pre-malignant disease.

CASE II.—Male, aged fifty-five years, referred by Dr. John Dunn for consultation as to possible malignancy of the larynx. The patient complained of "soreness and stiffness" on talking and swallowing, and impaired voice, in varying degrees, for two years. He had been treated by various laryngologists for chronic tonsillar disease, chronic pharyngitis and chronic hypertrophic laryngitis for a number of years prior to coming under Doctor Dunn's observation. Internists had been able to reduce a blood-pressure of 200 to 145; and they had been able to control a chronic nephritis and a cardiac lesion. On mirror examination the larynx was found infiltrated and thickened evidently by a prolonged chronic laryngitis, the thickening in the posterior commissure being almost similar to that seen in pachydermia. The similarity was increased by small crusts visible below the glottis. The thickened hypertrophic mucosa rolled out of both ventricles on phonation in a way that would, I think, be regarded by some laryngologists as an eversion of the ventricle. The roll obscuring the region of the right cord was granular and roughened. No definite form of a cord could be made out on either side, and both sides overlapped on phonation, the sound of which was as rough and deep as if made with the ventricular bands, though these did not touch. Doctor Dunn, from mirror examination, regarded the laryngeal condition as probably cancerous. While the writer did not feel so strongly impressed in that direction it seemed to be a case in which a specimen might well be taken for diagnosis. This was, however, contraindicated by the fact that if the laryngeal condition were found histologically malignant operation would be inadvisable because of the patient's arteriosclerosis and his cardiac and renal conditions.

Three years later the patient was again sent by Doctor Dunn for consultation. The patient had pain in the larynx radiating to the ears, tenderness over the larynx and over palpable lymph-nodes on both sides of the neck. Dyspnoea was quite troublesome at night; but not so noticeable during the day except on exertion. Mirror examination showed the larynx narrowed by encroachment from both sides, and the anterior wall. On the right side there was a bulging mass of fungations from an ulcerated base occupying the location of the cord and ventricle. The glottis was occluded in its anterior portion. The mobility of both arytenoids was impaired. The condition was clearly inoperable not only because of involvement of the party wall and extensive lymphatic leakage, but because of the cardiac, vascular and renal conditions. Evidently radium offered the only hope of palliation, if the condition proved malignant; but it was also evident that enormous dosage would be required and such dosage would not be justifiable unless certain of malignancy. It was, therefore, decided that I should take a specimen. The histologic report of Dr. A. G. Ellis was "squamous-cell epithelioma."

## CHEVALIER JACKSON

Radium treatments were carried out by Dr. William S. Newcomet and had a decided effect in reducing the infiltration both in the larynx and in the neck. The lumen of the chink increased in area. The patient died of angina pectoris three and one-half years after Doctor Dunn first made the diagnosis of cancer, from laryngoscopic appearances.

*Comment.*—The progress of the case indicated the correctness of Doctor Dunn's mirror diagnosis of malignancy. The case was undoubtedly one of those slowly developing laryngeal cancers that run a protracted course, in this case over three years. Thyrochondrotomic removal could not have been adequate; laryngectomy, if not fatal, could not have given more than the five and one-half years the patient survived. The phase of the case that bears on precancerous disease is the long duration of a laryngeal irritation and hypertrophic laryngitis, from defective metabolism, vocal abuse, cigarette smoking, tonsillar disease, etc.

CASE III.—Miss A. K., aged forty-nine years, referred by Dr. Preston M. Hickey and Dr. Herman H. Sanderson, for diagnosis of suspected malignancy of the larynx. The patient gave a long and interesting history of laryngeal disease.

The voice during childhood had been harsh at times so that people thought she had a "cold." At the age of twenty years the patient took up vocal training and the voice cleared so that for six years she sang mezzosoprano in church. For one year the patient gave singing lessons. At the age of twenty-nine years the singing voice was lost, and the speaking voice became increasingly hoarse. The patient then entered the Long Island Hospital for training as a nurse. At the age of thirty-one Dr. Thomas R. French saw her larynx. He has kindly furnished me the following notes: "Hoarse for two or three years, which she attributes to strain in singing. Throat easily tired on use of the voice. No pain. Larynx appeared normal in color and movements; but a small flat, very white growth (or crust) was noted below the anterior commissure." A beautiful water-color drawing of this growth was made by Doctor French. The growth was still present four months later. The left aryepiglottic fold was œdematous and later congestion of the left vocal band was noted.

At the age of thirty-three years the patient became aphonic. She then came under the care of Dr. Herman Sanderson, who found a papillomatous condition with a thickening of the left ventricular band.

At the age of thirty-seven years the patient being still aphonic, Dr. Chevalier Jackson, holding a clinic at the Harper Hospital in Detroit, removed a specimen from the larynx, which was reported as insufficient for diagnosis. At the age of forty-five, a degree of phonation was noted for a period of a year. At forty-six, the patient lost her voice every time she "took cold." The cords were noted by Doctor Sanderson as thickened but not red. At forty-seven, the voice was permanently lost and dyspnoea became noticeable. Dr. A. B. Wickham gave a series of violet-ray treatments which greatly improved the dyspnoea. Recently, however, the dyspnoea has reappeared.

At the age of forty-nine years, almost thirteen years after I first saw the patient, she was again referred to me by Doctor Sanderson for the taking of a specimen and the relief of the increasing dyspnoea which had become exceedingly distressing and was threatening asphyxia at night. Except for dyspnoea the general condition of the patient was good, she felt perfectly well, and had lost only three pounds in weight. There was marked indrawing of the guttural fossa and around the clavicles. Otherwise the general examination was negative.

*Laryngoscopic Appearances.*—Mirror examination showed nothing resembling cords. From the inner border of the arytenoids downward the larynx on each

side was filled with a nodular mass of tissue that obliterated the glottic chink except for a small triangular space posteriorly. Attempted phonation showed good movement of the arytenoids, but the movement brought no cords into view.

*Direct Laryngoscopy and Removal of Specimen.*—The dyspnoea having increased until tracheotomy was indicated, a direct laryngoscopy was done. The larynx was found infiltrated (though not hard) from the border of the ventricular bands downward. An ample specimen was removed with basket punch forceps, the tissue being soft and cutting easily; time, 1 minute 45 seconds. A second specimen was taken after 9 months, radium having been used in the meantime. Both reports follow:

*Histologic Report*, by Dr. B. L. Crawford. First examination: "Specimen consists of a fragment of tissue, measuring 0.75 cm. by 0.75 cm. by 0.5 cm.; weight less than 1 gm. One side is flat, apparently the base; the other aspect is rounded. A small spicule extends from one margin but does not appear to have a pedicle.

"Rapid technic.

"Histology: Sections show a diffuse infiltration of connective tissue and muscle by solid masses of squamous epithelium which has undergone no keratinization. In some areas marked leukocytic infiltration and hemorrhage can be seen. The mucosa is absent except at one margin of the surface.

"Diagnosis:—Basal-cell epithelioma."

Second examination:—"Specimen consists of a small irregular grayish piece of tissue measuring 0.75 cm. by 0.5 cm. by 0.25 cm. The tissue is friable.

"Formalin-alcohol fixation.

"Histology:—The small piece of tissue possesses a membrane of stratified squamous epithelium on one surface which is inflamed and ulcerated; on the opposite surface is a small strip of cartilage. The submucous tissue is extensively infiltrated by masses of epithelium. The infiltrating epithelium at site of ulcerated area is continuous with the surface epithelium, and there are also isolated nodules beneath that portion of the mucosa which is intact. The infiltrating epithelium shows little evidence of differentiation, for the most part the cells being irregular in shape and size; however, in places the cells resemble those of the prickly layer and in small areas show slight indication of keratinization. There is also extensive leukocytic infiltration throughout the tissue.

"Diagnosis:—Squamous-cell epithelioma."

Tracheotomy was done under local anaesthesia. Recovery prompt and uneventful.

The patient was then referred to Dr. D. Bryson Delavan and Dr. Thomas R. French for consultation. They decided to place the patient under the care of Dr. Douglas Quick for energetic treatment by radium. She is still under the treatment and is improved.

*Comment.*—Here is a case in which there was laryngeal trouble and vocal abuse for thirty years or more. Neoplastic conditions were present for at least thirteen years before the diagnosis of cancer was made. Over twelve years elapsed between the specimen reported insufficient and the one reported positively for cancer. It is impossible to say when the pathologic process took on malignant qualities. No one can regard the condition as malignant for thirty years. We must therefore grant that at some stage not yet cancerous the epithelial cells were preparing to sally forth on the invasion that we recognize histologically and clinically as cancer. *That stage was precancerous.* This fact is not altered by our inability to detect its presence in a given case.



## CHEVALIER JACKSON

CASE IV.—A. R., male, aged forty-two years, had had hoarseness off and on for a number of years, the voice being normal or nearly so in the intervals. He had a chronic hypertrophic laryngitis for which he had been treated at various times for a number of years. About a year prior to consulting me an able laryngologist had noted on the centre of the right cord, "A limited patch of white thickening similar to a keratosis." The patient failed to appear for reëxamination until eleven months later when the same laryngologist noted that "practically the whole extent of left cord was replaced by a snow-white rough growth. The cord moved but appeared sluggish."

This was also the condition upon my first examination. (Fig. 1.) Prior to coming to me the patient had been seen by Sir St. Clair Thomson, Mr. Hunter Tod and Mr. Herbert Tilley. We were all of a similar opinion that while a benign condition such as a keratosis could not be excluded without histologic examination, yet the strong suspicion of malignancy warranted prompt action and especially so as the growth was extending toward the arytenoid region, where the chances of operative cure, if malignant, would be, to say the least, much lessened. It was, therefore, decided that Dr. Ellen J. Patterson and I should do a thyrochondrotomy, and, after splitting the thyroid cartilage, decide upon the question of how radical the removal should be. Doctor Patterson and I operated on January 3, 1916. The following is a copy of the report of operation:—

"When the larynx was opened the growth did not look manifestly malignant to us. There was no detectable infiltration, no extension downward beyond what might be called the lower limits of the cord. The slightly nodular appearance mentioned by Mr. Tod, and which seemed to us quite marked at indirect laryngoscopy, was not so much in evidence at thyrotomy. On the other hand it did not resemble any benign growth. The experience we all have had with growths of the clinical characteristics of this one led me to decide, in consultation with Dr. Patterson, to remove the entire growth with a wide base of normal. The growth, however, was so manifestly superficial that we did not deem perichondrial dissection with complete left-sided evisceration necessary.

"Dr. Ernest W. Willetts immediately examined the frozen section and his preliminary report on a frozen section was 'precancerous.'"

"Microscopic Examination:—The only pathological change noted in sections is confined to the epithelium. This shows very marked thickening with a tendency to form down-growths into the underlying tissue. Immediately beneath the epithelium there is quite a thick layer of lymphocytes and plasma cells which are seen particularly just underneath that part of the epithelium which shows the thickening.

"For the most part the epithelial tissue is sharply defined from the underlying tissue but at several points this is not so sharply marked. Some of the cells are atypical as to size and staining. At several points there appears to be beginning hornification within the centre of the epithelial plugs like the very first beginning of the epithelial pearls such as are seen in epidermoid carcinoma.

"Diagnosis:—Precancerous condition or possibly just beginning epidermoid carcinoma."

Doctor Willetts sent slides to Dr. James Ewing who reported as follows:

"Your laryngeal specimen is very interesting and rare. I have no doubt that you are justified in believing that this is one of the ways intrinsic cancer of the larynx begins. It may not be the only one. The sudden transformation from the normal to the hyperplastic and atypical epithelial pegs is very striking and at once sets the progress apart from inflammatory changes.

"I do not think the condition can at present be called cancer. It has not any of the essential features, not even sufficient atypical qualities of the cells.

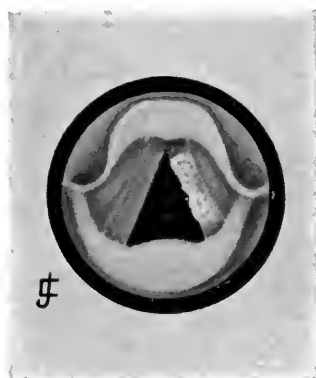


FIG. 1.—The upper illustration shows a keratotic disease of the left vocal chord that seemed clinically so suspicious of a cancerous or precancerous condition as to warrant removal. The histological findings after the removal of the entire growth were not inconsistent with this clinical opinion.

The lower illustration shows the fact that at laryngo-fissure the extension downward usually seen in malignancy was lacking, and the growth was rather less granular in appearance. Only a moderate removal was decided upon. At the end of five years the patient was still free from recurrence and had a fairly good voice. (Photoprocess reproduction of an oil-color drawing by Chevalier Jackson).



FIG. 2.—Extreme edge of pathologic process and approach to nearly normal contiguous mucosa. To observer's right slight reaction, some thickening of epithelial strata, and little increase in keratinized layer. Passing from left to right, just to left of middle of section, almost sudden change becomes obvious. Very notable overgrowth of epithelium which stains more deeply, often intensely, with loss of regularity and uniformity of cell arrangement and grouping, basal cells extremely polymorphous, of all sizes and without sharp, clearly cut, uniform border. Keratinization of outer stratum very marked near transition point and extending over more active area to left as well as over less changed tissue to right. At point of transition very intense mononuclear collections especially conspicuous between epithelium and old submucosa into both of which structures, however, mononuclear invasion occurs. Other sections showed more clearly and more conspicuously the changes mentioned, but were prepared by freezing, were not so well stained, and could not be photographed satisfactorily. (Photomicrograph from laboratory of James Ewing; tissue sectioned and stained by Ernest W. Willetts; legend dictated by W. M. L. Coplin.)

I have seen other beginning laryngeal cancers in which there was less overgrowth and more marked changes in the cells. I suppose the next step would be breaking away of the cells and invasion of the submucosa, but I should not expect this until the cells change their appearance considerably. This is the stage in which to treat cancer of the larynx, not after it gets well advanced." (Fig. 2.)

No sutures were used either in the cartilage or in the soft parts. The system of after-care originally devised by Doctor Patterson was skilfully carried out by her. The recovery was uneventful. The patient returned to England three months later and I have not seen him since; but a letter from Mr. Hunter Tod, eight months after operation, reported the larynx in good condition, with improving motility and favorable progress toward the development of an adventitious cord. The voice had returned and though still hoarse has lost the forced huskiness. I have heard through Dr. Herbert E. Smyth that the patient is alive and well.

*Comment.*—This case illustrates clearly and conclusively, I think, the value in laryngeal surgery of acting upon a clinical diagnosis of a precancerous condition. The case is a leading one in that the opinions of three eminent pathologists were to the effect, that, while the condition was not cancerous, and furthermore while they could not undertake to make any prognosis as to what the cells were going to do, yet they all seemed to regard the case as one in which they would not be surprised to see malignancy develop. In other words, they seemed to feel that the cells might be prepared or preparing to do something not already done, though the present limitations of histopathology would not warrant the positive statement of such an opinion.

This state of mind would seem parallel to that of the laryngologists concerned in the case. I believe every laryngologist of large experience can recall cases in which he regrets that he had not followed his undefined and undefinable feelings as to present or incipient malignancy in cases reported as histologically benign; and while it can, of course, in most instances be maintained on good grounds that there was malignancy in some unexamined portion, yet the clinical fact remains that had the laryngologist followed the guidance of an intuition born of clinical experience, the patient's life would have been saved. Just what constitutes the appearances in a laryngeal lesion that gives rise to a subconscious feeling of incipient cancer is difficult if not impossible to describe. In the same patient different laryngologists have given me quite different phases of the lesion and its history as the basis of their opinions, notwithstanding the fact that their opinions coincided as to the suspicions of malignancy.

Notwithstanding the fact that it would be manifestly out of the question for any pathologist to say on the basis of an examination of a removed dead cell what the adjacent living unremoved cells were going to do, I feel that the histologic appearances here go far to corroborate the clinical view that there is a curable precancerous morbid state that precedes malignancy in many cases of cancer.

*Treatment of Precancerous Conditions.*—As Coplin<sup>1</sup> has so well said: "The practical application of our recognition of irritation as a frequent antecedent of malignant disease becomes obvious. It is not necessary to assume

that there is a specific tumor excitant, cytologic, microörganismal or chemical, but that cancer often arises under influences the nature of which we cannot at present accurately define, but which tentatively may be termed irritative, fully recognizing how vague and unsatisfactory the designation must be. Fortunately, for practical purposes this particular indefiniteness is no impediment to our understanding the application to prevention and treatment. Every delay in healing of any non-suppurative process in which the normal tendency to repair is unduly prolonged, no matter where—skin, mucosa, lip, eyelid, tongue, stomach, intestine, rectum, bladder, mamma, vulva, uterus, prepuce or elsewhere—every irritated gland, wart or mole, becomes a source of suspicion.”

My experience in clinical laryngology leads me to believe that this clear and concise statement applies with especial force to the larynx.

If the author's views are accepted, the cure of chronic laryngitis becomes of fundamental importance. Unfortunately we are confronted at the outset by two obstacles in dealing with persistent intractable chronic laryngitis.

1. The difficulty of obtaining absolute rest for the larynx, especially in the cases due in part or wholly to occupational vocal abuse, dusty occupations, cough of extralaryngeal origin, and the like. Even the normal respiration of the dry overheated dusty atmosphere of the average dwelling in the United States is injurious to the individual larynx, peculiarly susceptible to such irritations.

2. Laryngectomy leaves the patient in such a deplorably crippled condition that we cannot consider for a moment the total removal of an otherwise incurable chronically inflamed larynx only suspected of being potentially cancerous, as has been so wisely urged by Bloodgood<sup>6</sup> in parallel cases of chronic mastitis. Nevertheless, the study of the case will usually find which causes, among the many, of a chronic laryngitis are operative; and having found them a cure will follow. Tonsillar infective diseases are well known factors in the production of chronic laryngitis. The writer was particularly struck with the discovery by Dr. T. R. French of a chronic tonsillar disease of long standing in the case reported here as Case IV; and his comments thereon are important.

Keratosis and similar overgrowths of epithelium occurring in adults are to be dealt with as potentially precancerous. The opinion of Dr. James Ewing commenting on the histology of a specimen in one of the author's cases (Case IV, above), namely that “this is the stage in which to treat cancer, not after it gets well advanced,” in my opinion expresses such a great clinical truth in such a great way, that it encourages me in making a plea before this Association for the clinical recognition of a precancerous condition. And while I realize that we cannot now definitely lay down specifications and descriptions of precise characteristics by which a precancerous condition can be identified in a given case, I think it will be a step toward the ultimate attainment of such an ideal if we begin by recognizing the fact that there exists a group of cases not already cancerous in which the malignant



possibilities are so great as to justify wide removal of normal tissue surrounding the base of the lesion. The general surgical rule, applying to individuals past middle life, that benign growths exposed to irritation should be removed, probably applies to the larynx as well as to any other epithelialized structure. In regard to papillomata, however, radical surgery and radium burns from excessive dosage are to be avoided as disastrous to the voice and the lumen of the airway as well as quite unnecessary for cure. Superficial removal and avoidance of all irritation such as tobacco-laden or dusty atmosphere, vocal abuse, the cure of tonsillar infections (see Doctor French's comment in Case III) will effect a cure with excellent vocal results. The author's case records show numerous instances in which papillomata, granulomata and cedematous polypi of the larynx have shrunk and in many instances disappeared by the sole influence of absolute silence.

## CONCLUSIONS

1. While there is here offered some evidence bearing on the histology of precancerous conditions, this evidence is not conclusive.
2. Clinical work is not, and never can be, ideally perfect. We are human and our patients are human. We cannot expect in our clinical work on the living human being to attain even to the relative certainty of the post-mortem room.
3. As laryngologists we are concerned with saving human lives from the inroads of a "dire disease," which is the appellation applied to cancer of the larynx by Sir Henry Butlin.
4. If we admit, as I think we should, that certain curable laryngeal conditions are in some cases the sequential predecessors of frequently incurable cancer, it is clearly our duty not only to eradicate those curable precancerous conditions, but to contribute to their early recognition by applying to them the term "precancerous," however faulty such a word may be from a purely scientific, histologic point of view.
5. From a clinical point of view we may regard continual laryngeal irritation from any cause, chronic laryngitis, keratosis, syphilis, pachydermia, so-called prolapse of the ventricle, and benign growths, occurring in a person of cancerous age, as clinically precancerous, in the sense that they may be contributory factors in the etiology of cancer, and as such should be cured, surgically or otherwise, as may be indicated.
6. It is no argument against this life-saving rule to contend that these conditions are too rarely predecessors of cancer to justify regarding them as etiologic factors in cancer. There is no known agent causative of any disease that will always, in all individuals, under average conditions of exposure, produce that disease. The human race would be extinct if such were the case.
7. The time has come for the laryngologist to follow the lead of the general surgeon and the gynæcologist in the recognition of the necessity of curing cancer before it starts.
8. There will be fewer deaths from laryngeal cancer when every mem-

ber of the medical profession fully realizes the frequently malign nature of chronic hoarseness.

BIBLIOGRAPHY

- <sup>1</sup> Coplin, W. M. L.: Injury, Inflammation, Irritation, Known Causes of Cancer; Their Recognition the only Safe and Sound Basis of Prevention, Jour. A. M. A. in process of publication.
- <sup>2</sup> Tilley, Herbert: Diseases of the Nose and Throat. Text-book. H. K. Lewis and Co., Limited, London, p. 605.
- <sup>3</sup> Ryland, Archer: Laryngeal Changes Induced by Mustard Gas. Journ. Laryngol., Rhinol. and Otol., May, 1919.
- <sup>4</sup> Thomson, Sir St. Clair: Disease of the Nose and Throat. D. Appleton and Co., 1912, p. 485. Thomson refers to Newman, Transactions Clinical Society of London, vol. xxii, p. 101, and to Sir Felix Semon, Brit. Med. Jour., April 7, 1888, p. 96.
- <sup>5</sup> Jackson, Chevalier: Endothelium of the Larynx. Pennsylvania Medical Journal, June, 1907.
- <sup>6</sup> Bloodgood, Joseph C.: Binnie's Regional Surgery, 1917, P. Blakiston's Son and Co.
- <sup>7</sup> Wright and Smith: Diseases of the Nose and Throat. Text-book, 1914. Lea and Febiger.

## ARTERIAL DECORTICATION

By C. LATIMER CALLANDER, M.D.

OF SAN FRANCISCO, CAL.

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF CALIFORNIA

IN 1918, Professor Halsted interested me in what was then the comparatively recent work on perivascular surgery, reported by René Leriche, of Lyons, France. An interesting observation on surface temperature, which bore definite relationship with certain features of interest in Leriche's work, was made at that time in the Surgical Clinic of the Johns Hopkins University.

The following are extracts from Doctor Halsted's reported case,<sup>17</sup> in which he ligated the left subclavian and carotid arteries near their origin from the aorta, for the cure of a huge, left subclavian aneurism. Two years after this proximal ligation, the aneurism developed a pulsation and grew larger, at which time the patient reentered the hospital and had it excised. The point of interest to this discussion is the fact that several hours after the excision of the aneurism it was noted that the left hand and forearm, which for the preceding two years had been strikingly cold, had now become abnormally warm, appreciably warmer than the corresponding limb on the sound side; and it was further noticed that the hand remained warm for several weeks after the operation. This rise in surface temperature over that portion of a limb distal to the complete removal of a segment of artery is one of the interesting phenomena which Leriche reports as following his operation of arterial decortication.<sup>37</sup> This hyperthermia he attributes to the vasodilation which, he says, accompanies removal of the sympathetic nerve plexuses about an artery. Any excision of an aneurism would necessitate, of course, the complete removal of these fibres, if such be present.

In a long series of papers, Leriche has called attention to sympathetic nerve plexuses which are said to lie in the intimate sheath of the large arteries and in the adventitia of these vessels, and he specifies that certain definite results follow the excision of these structures in the treatment of different syndromes. The surgical removal of these structures, an operation called by him "Sympathectomy,"<sup>27</sup> was conceived, proposed and accomplished in 1889 by his teacher, Jaboulay,<sup>24</sup> who performed it with curative results on the femoral artery in certain perforating ulcers of the foot, and to a less successful degree, on the coeliac trunks in certain visceral disturbances, the nature of which has not been ascertained. Before considering the rôle which the sympathetic fibres are said to play in these clinical pictures, we will enumerate the steps in the operative procedure.

### TECHNIC OF THE OPERATION

Leriche has designated his operation as an "Arterial Sympathectomy," according to the arterial level at which it is performed, axillary, brachial, iliac, or femoral.<sup>27</sup> The main arterial trunk is exposed by the classic route of

access a considerable distance proximal to the part affected. Thus the brachial artery is the operative site of election for disturbances in the forearm and hand, and the common or superficial femoral arteries for lesions in the foot or leg.

The external fibrous sheath covering the artery is incised for a distance of eight to ten centimetres, and the artery, with its inner, more intimate sheath and its adventitia, is now exposed. This inner sheath, which is fused with the adventitia of the artery, is grasped with tissue forceps and is incised directly on the vessel wall. Traction is maintained on one of the lips of the sheath of filmy tissue thus isolated, and this structure is completely freed from the artery over the length of the incision with a knife or fine scissors. The artery is in this manner stripped of its external coat, together with the fibrous tissue which is adherent to it.

Occasionally, one is able to remove only small cellular fragments of this external layer, but at other times definite laminæ may be dissected away. Leriche lays much stress on the complete removal of the thin meshes of loose tissue which adhere to the body of the artery, and the thoroughness of the removal of these strands is seen when the artery is gently swabbed with a moist gauze. With the artery thus moistened, it assumes a whitish, felt-like appearance, and the more or less detached débris, which clings to it, is easily seen. This arterial decortication is continued until the main body of the artery appears as a smooth homogeneous surface.

In the course of the operation, one is required to expose any collateral branches present in order to guard against their injury. Should these require ligation, we have found it prudent to ligate them at some little distance from the parent trunk in order that the decortication be completed without stripping these ligatures. In several of the cases here reported, the exposure of the operative field and the ease and safety of manipulation have been facilitated by grossly freeing the chosen segment of artery from the neighboring structures over the requisite distance, cutting the collaterals where necessary, and leaving the artery and its intimate sheath for the time being intact. A sheet of rubber tissue may then be drawn under the artery from side to side and clamped to the four corners of the wound, after which the more minute dissection of the artery is completed. Certain objective reactions in the hands of Leriche and his compatriots have been found to follow and be consequent upon this procedure.

#### POST-OPERATIVE OBJECTIVE REACTIONS

1. *Reaction of Visible Arterial Contraction* <sup>27</sup>.—As an immediate consequence of the denudation of the artery, a diminution in its calibre takes place until it has progressively reduced in size during the operation to that of a small, whitish cord, reminding one of a nerve trunk. In our series of ten decortications, five on the femoral and five on the brachial arteries, we were able to verify this and Leriche's further observation that the arteries of larger calibre were much slower in their contraction than the smaller. We

found indeed that the femoral artery was rarely much reduced in calibre. In two of these femoral cases no contraction whatever in the artery took place.

In the decortication of the brachial arteries only did we notice that pulsation could be neither seen nor felt as the operation progressed, a fact due to the local constriction of the vessels in the operative field. In two instances, the pulsations disappeared over the distal portion of the artery, while it could still be made out in the proximal area. Toward the end of three of the operations on the brachial artery, pulsation was seen to reappear.

2. *Reaction of Vasodilation with Hyperthermia*<sup>27</sup>.—Whereas Leriche constantly found a post-operative increase in surface temperature over those parts distal to the decortication, we were able to ascertain this in but one patient. He stated that this increase in temperature was at times noted on the evening of the operation, more often on the following morning, but usually occurred thirty-six hours after the operation, and marked the onset of the reaction of vasodilation.

In most of the instances recorded by Leriche, the local hyperthermia disappeared about the fifteenth day after the operation, a fact which illustrates the transitory character of the reaction. In connection with this previously mentioned case of Professor Halsted may be mentioned a patient in whom a quadruple ligation and excision of the sac was performed for the cure of an arteriovenous aneurism of the axillary artery.<sup>2</sup> The forearm and hand of this patient were much warmer four months after the operation than those on the sound side.

Lesions, other than those mentioned, may result in an elevation of surface temperature. This may occur in the upper extremity following injury to the median and ulnar nerves, and it is probable that such lesions injure the sympathetic fibres which course in the nerves and which are destined for the skin capillaries. Vincent<sup>2</sup> has observed hyperthermia in the arm of a soldier, who was injured in the axilla and who presented signs of lesion of the median and ulnar nerves, and in whom, at operation, was discovered injury to the brachial plexus. Gorodiche<sup>2</sup> reports a patient with hyperthermia of the forearm and hand, who was wounded in the inner aspect of the upper arm ten weeks before, and who showed symptoms of injury to the median nerve. This hyperthermia definitely exceeded the boundary of the sensory field of this nerve.

3. *Reaction of Increased Peripheral Blood-pressure*<sup>27</sup>.—Leriche reports a constant post-operative rise in the systolic pressure distal to the point of operation, but we have been unable in any of our cases to verify this observation. He has found an increase of as much as 40 mm. of mercury, and states that the maximum elevation of pressure is reached on the second or third day. This local hypertension becomes attenuated in the days that follow, until it is completely dissipated about the same time as in the excess surface temperature. His estimation of diastolic pressure showed no pronounced variation. His observations were made with a Pachon oscillometer

and his readings were taken at the malleoli and at the wrists, where the dressings interposed no variation.

Claude Bernard<sup>7</sup> suspected that the greater accumulation of blood in a part would lead to hyperthermia resulting in an increase in blood-pressure. In order to study the action of the sympathetic fibres going to the head, he conceived a method of differential mercury manometry, and was able to indicate by a simple difference in mercury level all modifications of pressure in two symmetrical arteries of the face. He made his experiment upon a horse, and his manometer consisted essentially of a U-tube with branches partially filled with mercury. One end of this instrument was joined by a tube to the right labial artery and the other to the left. Under normal conditions the manometer was at rest and the mercury remained at the same level in both limbs. When, however, the cervical sympathetic chain on one side was cut, the pressure in the manometer on that side rose, and the difference in pressure between the two sides in five experiments measured respectively, 40, 60, 60, 31 and 25 mm. of mercury. It may be worthy of note to here mention the fact that upon galvanization of the distal cut end of the cervical sympathetic, the distal, as well as the proximal portion of the cut artery, contracted. This is definite proof that the vasoconstrictor fibres of the sympathetic system in the head do not travel along the artery, but reach it at different levels.

This local hypertension is based by Leriche on the theory that the vasodilation, which accompanies the decortication, permits a greater quantity of blood to be propagated to the periphery, and this increased flow results in an increased head of pressure.

#### THEORY OF MODES OF INJURY TO THE SYMPATHETIC FIBRES

Trauma of some sort to the sympathetic fibres is claimed to be the causative factor in the clinical condition which Leriche relieved by this operation. According to him, the fundamental trouble is a disturbance in the vasomotor innervation, with a resulting vasoconstriction forming the basis for the syndromes. His basic assumption is that sympathetic vasomotor fibres course along and ramify in the periarterial nerve plexuses of the extremities. He designates three possible varieties of trauma which result in the disturbance of the vasomotor balance of the extremities, and are the cause of certain definite clinical pictures.

The mechanism of the first mode of injury assumes trauma to the afferent spinal nerve fibres in the tissue of the extremities not necessarily in the immediate vicinity of the vessels or nerves. Traumatic excitation of these sensory fibres conveys impulses which travel to the ganglionic and medullary centres, which cause a reflex vasoconstriction of perhaps the whole extremity. On the basis of this traumatic reflex vasoconstriction, he explains a case in whom there was a definite pre-operative hypothermia proximal to the level of the area traumatized. This patient was injured in the lower third of the superficial femoral artery, but the lowering of the surface temperature was noted as high as the gluteal region.

In the second variety of trauma, he states that vasoconstriction in a distal part may arise, not by reflex action, but by direct injury to the efferent sympathetic fibres, which are said to lace the arteries with a periarterial network. When these are traumatically irritated but not destroyed, they overact and convey stronger impulses to the periphery than normal, a phenomenon which results in increasing the vascular tone to the point of vasoconstriction, resulting in hypothermia.

He theorizes still further on another variety of injury to the efferent sympathetic fibres in these arterial plexuses, which is destructive in its nature. This destruction of the vasoconstrictive element, which he thinks preponderates, results in a paralytic vasodilation and hyperthermia. It is by this third mode of injury that Leriche would explain the hyperthermia that followed the excision of the subclavian aneurism in Doctor Halsted's patient, since the efferent fibres accompanying the artery were of necessity sacrificed when that portion of the artery containing the aneurism was resected. The vasoconstrictor element is the more prominent in the first two types of lesion, resulting in hypothermia, and the vasodilator element preponderates in the third variety, with a consequent increase in surface temperature. This complex vasomotor situation, however, may be further complicated by the reduced quantity of blood going to the extremity as the result of partial or complete obliteration of the artery, as well as by the consequences of immobilization of any muscles which may be paralyzed. Thus it may readily be seen from the imagined variety of lesions and the amount of possible injury to the artery and nerve, that there may result all gradations from hyperthermia to hypothermia. In cases of decreased, as well as those of increased surface temperature, however, it is noted that there has been a tendency for the normal thermal equilibrium to become established, and Leriche thinks that this restoration of vasomotor balance is brought about by a reestablishment of the sympathetic nerve continuity by means of the plexuses on the collateral arteries.

In all of the patients for whom he claims relief, he has noted, before the operation, a hypothermia of the affected extremity, which he explains on the basis of a traumatic vasoconstriction. The fundamental point in his therapy is the restoration of vasomotor balance in the part. This restoration he claims to accomplish by excising normal sympathetic fibres from the parent artery of the affected extremity at a point proximal to the lesion.

#### CLINICAL PICTURES OF THE DISORDERS CURED BY LERICHE

We cannot compare our results with those of Leriche, since none of our cases correspond to those in whom he obtained such spectacular cures. In his hands the operation was successful in a number of unassociated clinical pictures of a rather vague description, but which he considers have in common a disturbed vasomotor balance.

1. *Traumatic Disorders of Babinski-Froment Type*<sup>18-34</sup>.—The clinical picture described by these men develops after minor injury to the limbs

involving only the soft parts, and the severity of the lesion is not at all proportional to the intensity of the symptoms. Clinically, the disease is described as presenting a definite syndrome which includes contractures and pareses, which develop almost immediately after traumatism.

The motor changes are accompanied by none of the objective signs characteristic of typical organic affections, such as follow lesions of the central nervous system or large vessels. They resemble in many features manifestations of hysteria and one who has not seen but has merely studied reports of this condition, is forced to note this similarity. Unlike hysterical phenomena, however, these patients resist counter-suggestion.

In addition to contractures and pareses, the complete picture may present muscular atrophy, exaggeration of the knee-jerks, and changes in the cutaneous reflexes, together with disturbances in objective and subjective sensibility. Vasomotor, secretory and trophic disturbances are noted in the bones, skin, hair and nails. French neurologists admit that its pathogenesis is still unsettled, but claim that these disorders, whatever names they may receive, constitute a special group, half-way, as it were, between organic affections on the one hand, and hysterical phenomena on the other.

Leriche considers that these symptoms arise from injury in the depths of the tissue, to the sensory and motor terminals as well as the sympathetic fibres, and that from such injury there may result an infinity of small nerve lesions which reflexly result in the vasoconstriction responsible for the condition.

2. *Causalgia of Weir Mitchell*<sup>51</sup>.—Another rare but well-recognized clinical picture, which has yielded to arterial decortication in Leriche's hands,<sup>25</sup> is the causalgia of Weir Mitchell. This syndrome in essence is a painful form of neuritis of the median nerve and described by him during the Civil War and called "Causalgia," from the Greek, meaning "I burn." Its causative factor is trauma and the predominant symptom is pain. In this clinical picture the elbow is flexed, the wrist slightly radially curved, and the hand raised with the fingers extended, with occasional hyperextension of the terminal phalanges. The hand is emaciated and atrophied, making the fingers thin and tapering. Motor disturbances are usually slight and total paralyses are consequently few, although slight weakness in movement is sometimes made out.

The subjective sensory disturbances are the most distressing symptoms, and paroxysms of pain usually occur a few days after the wound is inflicted. This pain is moderate in intensity in the early stages of the disease, but progressively increases. The patient refers it to a semicircle extending from the root of the thumb to the root of the index or middle finger, and it reaches its height four or five months after injury, when it very slowly diminishes in severity.

In considering the mechanism of causalgia, it is probable that we are dealing with trauma to the fibres of the sympathetic system which accompany the median nerve, and which supply the glands, capillaries, and nerve endings



of the different layers of the skin. It has been suggested also, that the symptoms may be the result of injury to the nutrient artery of the median nerve,<sup>9</sup> together with lesion of the sensory fibres in this trunk. Complete cures of this condition have followed decortication of the brachial artery.

3. *Results of Excision of Obliterated Arterial Segments*<sup>37</sup>.—In limbs affected by arterial obliteration due to trauma, a variety of vasomotor, motor and sensory disturbances ensued. At operation is found an impermeable fibrous cord, or the remains of scar tissue, in which the artery cannot be recognized. With the removal of this obliterated segment, however, Leriche has noted marked improvement in these cases, and he concludes from this fact that the fibrous cord of an artery is not an indifferent structure, but is a real nerve, whose functions, due to injury to the perivascular nerves, have become perverted.

4. *Spontaneous Ulcers in Amputation Stumps*<sup>32</sup>.—Certain ulcers which occur in amputation stumps over areas where there is no pressure, and which are definitely not caused by infection, are very refractory in their treatment. In this condition the affected stump is cold and œdematous, and any granulations present are very friable. The lesion begins as a vesicle, which later bursts and becomes an ulcer. It shows no tendency to heal but continues unimproved over months and renders the use of apparatus impossible. According to Leriche, after decortication of the femoral artery, several of these ulcers have closed promptly, and their scars have remained resistant enough to bear the use of apparatus.

#### FUNDAMENTAL DETAILS OF THE AUTONOMIC NERVOUS SYSTEM

Since Leriche states that both the mechanism of production of these lesions and that of their cure rest upon the involvement of the sympathetic fibres, it is fitting that we review the fundamental physiologic and anatomic bases governing these fibres before we go further.

As there has been much loose teaching and writing concerning the autonomic nervous system, of which the sympathetic division is but a part, and as there is some controversy about the paths along which the fibres of this division run, a portion of this paper will be devoted to considering our present knowledge on that subject. No apology need be made for summarizing Langley's admirable survey<sup>23</sup> of the subject, since the facts which have accumulated are so numerous that it is imperative to try to coördinate them, and since results published on trivial evidence and faulty premise serve but to obscure the issue when no general scheme is borne in mind.

The autonomic nervous system includes the motor nerves which control the activity of the unstriated and cardiac muscle tissue and all glandular structure, and its several divisions take their origin from separated portions of the central nervous system. All of these efferent autonomic fibres leave the spinal cord in four regions, each of which is separated from the other by areas in the brain and cord, from which no autonomic fibres pass. Since the mid-brain, bulbar, and sacral autonomic divisions have no connection with

the sympathetic autonomic fibres which supply the extremities, we will confine our attention to the sympathetic section of this great system. The cord cells of the sympathetic autonomic division lie in that portion of the spinal cord from the first thoracic to the second or third lumbar segments, inclusive; and it is with the fibres of this division that we are especially concerned in this paper.

To properly appreciate the peripheral course of the sympathetic fibres, we must be familiar with the nerve unit of the sympathetic division. In common with the other divisions of the autonomic system, this unit consists of a central and a peripheral neuron. The central of these neurons for any given segment has its nerve cell in that segment of the cord, and this cell sends out its axon from the cord by way of the anterior root of the corresponding spinal nerve. This axon is a medullated nerve fibre and outside of the cord it emerges from the anterior root to end in one of the ganglia of the sympathetic system, and is therefore called the pre-ganglionic fibre of that particular unit. This axon leaves the anterior root in company with other similar axons from similar cells in the same spinal segment, and they leave the anterior root in a trunk which is called the "white communicating ramus." This ramus is white because this group of pre-ganglionic fibres are medullated.

The sympathetic ganglia, about which these pre-ganglionic fibres form connections, are essentially groups of nerve cells of the peripheral neurons, whose function it is to give off non-medullated axons, known as the post-ganglionic fibres. These fibres are grouped into trunks of fibres, each of which courses back to the root of the corresponding spinal nerve, and this trunk is known as the "gray communicating ramus," from the fact that the post-ganglionic fibres which are contained in it are non-medullated.

The sympathetic ganglia of the sympathetic division are divided into two groups, the paravertebral, or lateral sympathetic chain of ganglia, and the pre-vertebral, or the co-lateral system of ganglia. Since we are engaged in the study of those fibres which run to the extremities only, we are not concerned with the prevertebral ganglia, from which emanate fibres which run to the viscera. The common characteristic, then, of all of the lateral ganglia is that each of the nerve cells there contained sends its post-ganglionic fibre back to the cerebral spinal nerves to be therein distributed to the body wall and the extremities.

*Course of the Sympathetic Fibres to the Skin of the Extremities.*—From what has just been said, we know that the fibres which run to the skin of the extremities leave the lateral sympathetic chain by way of the gray, non-medullated, post-ganglionic fibres, and course to their destination *via* the spinal nerves. Thus these fibres are contained in the cutaneous branches of these nerves, and run with them to the skin, a fact of dominant interest in this discussion. It has been generally believed that some sympathetic fibres make their way to the periphery along the sheaths of the arteries, but definite proof that they follow the arteries has not been adduced.

Indeed, it is the opinion of physiologists that the course in the cutaneous

nerves is the correct one. There is this point, however, to be borne in mind, that the sympathetic system does send fibres direct to the aorta, and that these appear to spread some distance down along the larger arteries. It is not unlikely that these nerve fibres cause some contraction in these vessels, and that in this way a modification of the blood supply to the skin and to the muscles may take place without any direct action on the peripheral vessels.

*Course of the Sympathetic Fibres to the Skeletal Muscles.*—Since we have seen that the gray rami, which run to the spinal nerves, contain sympathetic fibres which are destined for the innervation of the skin, we may expect that also in these gray rami go the fibres which supply the muscle, and that these muscular nerves send vasomotor fibres to the arteries in the muscle.

#### HISTORIES OF CASES OPERATED IN THIS SERIES

CASE I (Group 1).—E. H., male, age thirty-eight years. *Complaint:* Pains in the left hand and right foot.

*Present Illness and Local Condition.*—The patient has suffered since boyhood from chilblains and numbness of the feet in winter. Six years ago the small toe of the right foot became gangrenous to the middle phalanx and the toe was amputated. Gangrene next affected the third toe on the right foot, and amputation followed. Later the leg was amputated at the ankle. Two years later all toes of the left foot became gangrenous and the foot was amputated at the tarso-metatarsal joint. After one year, the index finger of the left hand became gangrenous and was amputated. One year previous to admission in October, 1921, the stump of the left leg began to slough and the leg was amputated below the knee. Upon entering the hospital this stump was again affected and was amputated at the upper third of the thigh. The arteries in all extremities showed normal pulsation.

*Operation.*—Decortications of the right femoral and the left brachial arteries were performed in the effort to stop the ascending gangrene. *Result:* The gangrene in both operated extremities gradually progressed until his death one year later. *No improvement.*

CASE II (Group 1).—P. O., male, age forty years. *Complaint:* Pain in both lower extremities, for the most part confined to the large toes; ulcerations on the mesial surface of both large toes and violent color changes in the feet.

*Present Illness and Local Condition.*—Four years ago the patient first noticed numbness and pain in both feet while on the march. A short time later two deep ulcerations occurred, one on the mesial surface of each great toe, and all attempts to heal these ulcers by hydrotherapeutic and orthopædic measures were without avail. Peripheral arterial pulsation normal.

*Operation.*—Bilateral femoral decortication and left brachial decortication. *Result:* Marked improvement immediately followed the operation in the lower extremities, as evidenced by the disappearance of the disturbed color changes and the healing of the ulcers into scars. But these scars later broke down and the ulcerations reappeared. For some time an improvement was noted in the left hand and arm, but the pain soon reappeared and the condition is now as before the operation. *No improvement.*

CASE III (Group 1).—E. D., female, age sixty-three. *Complaint:* Paroxysmal pain in fingers of left hand, radiating up left arm.

*Present Illness and Local Condition.*—Twenty years ago both hands were numb, blue and white at intervals, especially on cold mornings. The condition has gradually become worse in the last ten years, until a year before her admission to the hospital in August, 1921, the finger tips on the right hand, and a little later

### C. LATIMER CALLANDER

on the left, grew painful and tender, and small suppurating areas appeared beneath the nails of all fingers. The local points of suppuration of the middle fingers of both hands were followed by gangrene, resulting in self-amputation of the terminal phalanges of these fingers. Pulsation was normal in all extremities. About the stump of the left middle finger was a puffy, œdematous area, with a ring of very pale skin adjacent to a distal gangrenous slough. The entire left hand was much more tender than the right.

*Operation.*—Typical decortication of the left brachial artery. *Result:* For some days after the operation the pain was diminished and the color changes in the skin were less marked. The pain, however, later became more severe and it was evident that the gangrene was spreading. For this reason the last three fingers of the left hand were amputated at the metacarpal-phalangeal joints, together with the terminal phalanx of the index finger. *No improvement.*

CASE I (Group 2).—C. E., male, age sixty-three. *Complaint:* Pain and ulceration over the dorsal surface of the middle toe, left foot.

*Present Illness and Local Condition.*—The patient entered the hospital in May, 1921, suffering from cramp-like pains in the left calf muscles, followed by pains in the toes of the left foot. The onset occurred five months previously, when a small spot of ulceration was noted on the dorsal surface of the small toe of the left foot. This ulceration developed into a deep slough, from which a purulent discharge was noted. Arterial pulsation was not present at either ankle or foot.

*Operation.*—Decortication of the left superficial femoral artery was performed a month after admission. *Result:* Several weeks after the operation the gangrenous ulcerated area healed into a very hard, resistant scar, and this area has remained healthy for over a year. *Marked improvement.*

CASE II (Group 2).—N. F., male, age sixty-seven. *Complaint:* Severe pain in the left leg.

*Present Illness and Local Condition.*—Two years ago patient noticed weakness in both legs, followed by intermittent, cramp-like pains on exercise, the pains extending from the foot into the thigh. In the last four months the pain was so severe as to render walking impossible. The left leg became violently hyperæmic, swollen and painful, especially in the dependent position. No arterial pulsations could be made out in either leg or below the bifurcation of the aorta. There was marked tenderness about the left knee, foot and ankle.

*Operation.*—Decortication of the left superficial femoral artery. *Result:* No improvement followed the operation and death occurred from ascending gangrene of the operated extremity. *No improvement.*

CASE III (Group 2).—A. C., male, age thirty-six. *Complaint:* Gangrene of the left index finger.

*Present Illness and Local Condition.*—From 1917 to 1921, the patient suffered with lupus erythematosus of the face, and during the period from 1919 to 1921, he had several attacks of circumscribed œdema in various portions of the body, affecting nose, eyelids, cheeks and legs. The legs were very œdematous at the time of admission into the hospital in March, 1922. Several months ago circulatory disturbances were noted in the fingers of the left hand, terminating in gangrene of the index finger with beginning trophic changes in the middle finger. The whole hand, and particularly the areas about the affected portions, was very tender, and pulsation in the left wrist could be made out with difficulty.

*Operation and Result.*—Decortication of the left brachial artery was followed by no change in the condition. *No improvement.*

CASE I (Group 3).—C. C. K., male, age thirty-five. *Complaint:* Excruciating pain over the palmar surface of the right thumb and base of the index finger.

*Present Illness and Local Condition.*—Patient suffered a slight bayonet wound in the elbow in 1918. Six months prior to admission to the hospital, in October,

1921, while working at the mechanic's trade, he gouged out a small segment of tissue from the radial aspect of the terminal phalanx of the right thumb, in which injury the knife cut to the bone. Although the wound healed four weeks later, there followed a constant burning pain in the area above mentioned, which was accentuated when the arm was in the dependent position. Two weeks later the scar tissue was removed, but there was no improvement in the pain. Examination showed an indented area on the thumb where the scar was removed, with this area and base of the index finger exquisitely tender to the slightest pressure. Arterial pulsation was normal. No definite diagnosis could be made other than a pain causalgic in character.

*Operation.*—Decortication of the right brachial artery was performed. *Result:* The pain in the finger was almost entirely relieved on the day following operation and disappeared entirely two weeks later. At this time, however, he developed pain and tenderness over the bodies of the flexor muscles of the right forearm, which pain disappeared after a period of several months. *Marked improvement.*

#### DISCUSSION OF THE RESULTS

In this series ten arterial decortications were performed on six patients, on one of whom three arteries were decorticated for disease of three extremities, while on another the operation was performed on two arteries for trouble in two extremities. We have made no clean-cut diagnoses in these patients, but have chosen to place them into three groups. In group 1, we have described those patients in whom the arterial changes at the time of operation were thought to be spasmodic in nature rather than obliterative, as evidenced by the presence of palpable, peripheral, arterial pulsation. In group 2 are mentioned those cases in whom an obliterative arteritis had seemed to play the predominant rôle, and where no arterial pulsation in the affected extremities was elicited. Group 3 is that of unaccounted-for pain, in which we have but one case.

In the first, or spastic group, Case I (E. H.) was operated upon with no beneficial result. In Case II (P. O.), no improvement can be recorded, since the violent skin discoloration and the sensation of cold in the diseased extremities have reappeared, and the ulcerations have returned. No improvement followed the operation in Case III (E. D.), in whom an amputation of several fingers had later to be resorted to.

In considering the second group of cases, in whose affected extremities no arterial pulsation could be elicited, one definite cure is reported, Case I (C. E.). Whereas for months this patient had an ulcerative gangrene of the dorsal surface of the middle toe of the left foot, several weeks following the operation the gangrene disappeared and the sloughing healed into a resistant scar, which has remained healthy over several months. In Case II (N. F.), no improvement followed the operation, and the patient later died from an ascending gangrene of the operated extremity. In Case III, no improvement followed the operation, and the gangrene remained as before intervention.

Case I, of group 3, was operated upon for an unaccounted-for pain in the thumb. Following the operation the pain disappeared, but for it was substituted another pain in the flexor group of muscles. This pain later likewise disappeared, and there has been no recurrence of the symptoms.

We wish to state here that we have operated upon no patients who exactly correspond in their diagnoses, or clinical pictures, to those treated so successfully by Doctor Leriche, and it would then appear illogical to pass hasty judgment on this operation from the results of the treatment of our series of cases.

There are, however, certain fundamental principles wherein we differ with Leriche. The conception of primary importance is the knowledge of the path of the vasomotor fibres to the extremities. One gains the conclusion, from careful study of his work, that he considers the majority, if not all, of the vasomotor fibres to the extremities follow the sheaths of, and lie in, the adventitia of the larger arteries. From what has been said concerning the path of these fibres, we see that anatomists and physiologists concur in the belief that they accompany and are embodied in the spinal nerves which run to these parts. If such be the case, the vasomotor sympathetic fibres must leave these spinal nerves at different levels in their course, and supply innervation to the arteries from point to point as this innervation is required. Hence, it is a gratuitous assumption, from the point of view of proven work, that these fibres run a course along the arteries, and that their continuity may be severed, irritated, or otherwise interfered with by a removal of a thin sheet of tissue about the sheath or adventitia. So far as physiologists can prove, the only sympathetic fibres which accompany the large arteries to their termination are those which run from the prevertebral ganglia to the thoracic and abdominal viscera. There now arises the natural question as to the proof that these sympathetic fibres are removed at the time of operation. Points of difficulty in the staining technic for the demonstration of these nerve fibres in the tissue thus removed from an artery, require that further work be done upon this subject. It is rather striking, also, that in our cases, save in one instance, we were unable to demonstrate any post-operative rise in blood-pressure, or increase in surface temperature.

We are, at this writing, forced to the conclusion that an insufficient number of observations of this operation has as yet been made. It is only by careful physiologic estimation of capillary,<sup>1</sup> surface temperature<sup>2</sup> and blood-pressure changes, that a correct conclusion is to be reached. In this discussion, however, we would not overlook the fact that great improvement in otherwise hopeless conditions, has resulted from this procedure, even though the mechanism of the production of the diseases and that of their cure is as yet unknown.

#### BIBLIOGRAPHY

- <sup>1</sup> Babinski, J., Froment, J. et Heitz, J.: Des troubles vaso-moteurs et thermiques dans les paralysies et les contractures d'ordre réflexe. *Ann. de méd.*, Paris, 1916, vol. iv, pp. 461-497.
- <sup>2</sup> Babinski, J., et Heitz, J.: Hyperthermia locale du membre supérieur droit, après résection d'un anévrisme axillaire, chez un blessé présentant une paralysie complète du plexus brachial du même côté. *Bull. et mém. Soc. méd. d. hôp. de Paris*, 1916, 3 S., vol. xl, pp. 2324-2327.

## ARTERIAL DECORTICATION

- <sup>3</sup> Benedict, F. G., and others: Human Vitality and Efficiency Under Prolonged Restricted Diet. Carnegie Institution of Washington, Pub. No. 280, p. 78.
- <sup>4</sup> Bénisty, Athanassio, Mme.: Troubles trophiques très marqués localisés au niveau d'un doigt à la suite d'une lésion vasculaire par plaie de la paume de la main. *Rev. neurol.*, 1914-1915, vol. xxviii, pp. 1229-1230.
- <sup>5</sup> Idem: Formes cliniques des lésions des nerfs. Paris, 1916, pp. 56-96; pp. 214-223.
- <sup>6</sup> Bernard, C.: Leçons sur la physiologie et la pathologie du système nerveux. 1868, vol. ii, p. 508.
- <sup>7</sup> Idem: Leçons sur la chaleur animale, 1876, p. 244.
- <sup>8</sup> Bonnet, G.: Les adaptations fonctionnelles au niveau des artères traumatisées. Thèse de Lyon, March, 1920.
- <sup>9</sup> Bourguet: Recherches sur l'irrigation des nerfs. *Compt. rend. Soc. de biol.*, April 5, 1915.
- <sup>10</sup> Boursier, P.: Contribution à l'étude du traitement chirurgical de la causalgie. Thèse Fac. Méd. Bordeaux, 1917.
- <sup>11</sup> Dastre, A. F., et Morat, J. P.: Recherches expérimentales sur le système nerveux vaso-moteur, Paris, Masson, 1884.
- <sup>12</sup> Ducastaing, M. R.: Note sur quatre cas de stupeur artérielle traumatique. *Bull. et mém. Soc. de chir. de Par.*, 1919, vol. xlv, pp. 606-611.
- <sup>13</sup> Ducoste, M.: Les syndrômes cubitiaux. Communication à la Soc. de méd. et de chir. de Bordeaux, July 2 and 10, 1915. *Gaz. hebd. d. Sc. méd. de Bordeaux*, 1915, vol. xxxvi, pp. 26; 81.
- <sup>14</sup> Dupin: Recherches d'histophysiologie pathologique sur les plaies des gros vaisseaux et leurs ulcerations secondaires. Thèse de Lyon, 1920.
- <sup>15</sup> Gibou, E.: Causalgies et syndrômes douloureux d'origine sympathique. *Presse méd.*, 1918, vol. xxvi, pp. 584-585.
- <sup>16</sup> Halper, A.: Ueber Mikrocapillarbeobachtungen bei einem Fall von Raynaudscher Krankheit. *Ztschr. f. d. ges. exper. Med.*, 1920, vol. ii, 3-4 Heft, p. 125.
- <sup>17</sup> Halsted, W. S.: A Striking Elevation of the Temperature of the Hand and Forearm Following the Excision of a Subclavian Aneurism and Ligations of the Left Subclavian and Axillary Arteries. *Bull. Johns Hopkins Hospital*, 1920, vol. xxxi, pp. 219-224.
- <sup>18</sup> Heitz, J.: Des troubles circulatoires qui accompagnent les paralysies ou les contractures post-traumatiques d'ordre réflexe. *Arch. d. mal. du coeur.*, 1917, vol. x, pp. 161-196.
- <sup>19</sup> Herbet, H.: Le sympathique cervical. Étude anatomique et chirurgicale. Thèse de Paris, 1900, p. 171. G. Carré et C. Naud, 1900, No. 245.
- <sup>20</sup> Howell, W. H.: The Sympathetic Nervous System. *Text-book of Physiology*, pp. 248-254.
- <sup>21</sup> Karajanopoulo: Sur un cas de causalgie. *Bull. et mém. Soc. de chir. de Par.*, Feb. 20, 1920.
- <sup>22</sup> Krogh, A.: Physiology of the Capillaries. *Jour. Physiol.*, 1918, 1919, vol. lii, pp. 456-474.
- <sup>23</sup> Langley, J. N.: The Sympathetic Nervous System. Schäfer's *Text-book of Physiology*, 1900, vol. ii, pp. 616-696.
- <sup>24</sup> Leriche, R.: De l'élongation et de la section des nerfs périvasculaires dans certains syndrômes douloureux d'origine artérielle et dans quelques troubles trophiques. *Lyon Chir.*, 1913, vol. x, pp. 378-382.
- <sup>25</sup> Idem: De la causalgie envisagée comme une névrite du sympathique et son traitement par la dénudation et l'excision des plexus nerveux péri-artérielles. *Presse méd.*, 1916, vol. xxiv, pp. 178-180. *Soc. de neur.*, 1916. *Rev. neurol.*, 1916, p. 184.
- <sup>26</sup> Idem: Du syndrome sympathique consécutif à certaines oblitérations artérielles traumatiques et de son traitement par la sympathectomie périphérique. *Soc. de chir.*, séance du jan. 31, 1917. *Bull. et mém. Soc. de chir. de Par.*, 1917, vol. xliii, pp. 310-314.

- <sup>27</sup> Idem: De la sympathectomie péri-artérielle et de ses résultats. *Presse méd.*, 1917, vol. xxv, pp. 513-515.
- <sup>28</sup> Idem: Notes sur la causalgie et sur son traitement. *Lyon chir.*, 1919, vol. xvi, pp. 531-569.
- <sup>29</sup> Idem: De la part du sympathique péroveineux dans la production de l'eczéma variqueux. *Lyon chir.*, 1919, vol. xvi, pp. 651-652.
- <sup>30</sup> Idem: De quelques effets de la sympathectomie périthyroïdienne supérieure. *Lyon chir.*, 1920, vol. xvii, pp. 109-111.
- <sup>31</sup> Idem: Des effets de la sympathectomie péricarotidienne interne chez l'homme. *Presse méd.*, 1920, vol. xxviii, pp. 301-302.
- <sup>32</sup> Idem: Traitement de certaines ulcerations spontanées des moignons par la sympathectomie périartérielle. *Presse méd.*, 1920, vol. xxviii, p. 765.
- <sup>33</sup> Leriche, R., et Convert, P.: Sur la mécanisme sympathique de l'hémostasie spontanée dans certaines plaies seches des artères. *Soc. de path. comparée*, Oct. 9, 1917. *Presse méd.*, 1917, vol. xxv, p. 603.
- <sup>34</sup> Leriche, R., et Heitz, J.: Résultats de la sympathectomie périartérielle dans le traitement des troubles nerveux post-traumatiques d'ordre réflexe (type Babinski-Froment). *Lyon chir.*, 1917, vol. iv, pp. 754-792.
- <sup>35</sup> Idem: Des effets physiologiques de la sympathectomie périphérique (réaction thermique et hypertension locales). *Compt. rend. Soc. de biol.*, 1917, vol. lxxx, pp. 66-70.
- <sup>36</sup> Idem: De l'action de la sympathectomie périartérielle sur la circulation périphérique. *Arch. d. mal. du coeur*, 1917, vol. x, pp. 79-91.
- <sup>37</sup> Idem: De la réaction vaso-dilatatrice consécutive à la résection d'un segment artérielle oblitéré. *Compt. rend. Soc. de biol.*, 1917, vol. lxxx, pp. 160-162.
- <sup>38</sup> Idem: Influence de la sympathectomie périartérielle ou de la résection d'un segment artérielle oblitéré sur la contraction volontaire des muscles. *Compt. rend. Soc. de biol.*, 1917, vol. lxxx, pp. 189-191.
- <sup>39</sup> Leriche, R., et Policard, A.: Sur quelques facteurs physiologiques élémentaires intervenant dans l'évolution des lésions traumatiques des vaisseaux. *Lyon chir.*, 1920, vol. xvii, pp. 242-249.
- <sup>40</sup> Idem: Etude de la circulation capillaire chez l'homme pendant l'excitation des nerfs sympathiques périartérielles et la ligature des artères. *Lyon chir.*, 1920, vol. xvii, pp. 703-704.
- <sup>41</sup> Idem: Adaptation fonctionnelle des artères liées à l'entendue nouvelle de leur territoire de distribution et conséquences thérapeutiques de cette notion. *Bull. et mém. Soc. de chir. de Par.*, 1920, vol. xlii, p. 142.
- <sup>42</sup> Idem: Quelques déductions thérapeutiques basées sur la physiologie pathologique l'artère humérale. *Lyon chir.*, 1920, vol. xvii, pp. 250-256.
- <sup>43</sup> Idem: Sur quelques faits de physiologie pathologique touchant les blessures du sympathique périartérielle, la contusion artérielle et l'oblitération spontanée des artères déchirées par un projectile. *Bull. et mém. Soc. de chir. de Par.*, 1919, vol. xv, pp. 718-727.
- <sup>44</sup> Létievant, J. J. E.: *Traité des sections nerveuses; physiologie, pathologique, indications procédés opératoires.* J. B. Bailliere et fils, éditeur, Paris, 1873.
- <sup>45</sup> Lortat, J., et Hallez, G. L.: Traitement de la "causalgie" du médian avec troubles paralytiques graves par la ligature du nerf au catgut. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1918, 3S., vol. xliii, pp. 239-243.
- <sup>46</sup> Marie, P., et Benisty, A., Mme.: L'individualité clinique des nerfs. *Rev. neurol.*, 1914-15, vol. xxxviii, pp. 280-291.
- <sup>47</sup> Idem: Une forme douloureuse des blessures du nerf médian par plaies de guerre. *Presse méd.*, 1915, vol. xxiii, pp. 81-82. *Bull. de l'Acad. de méd.*, 1915, No. 7.
- <sup>48</sup> Meige, H., et Benisty, A., Mme.: De l'importance des lésions vasculaires associées aux lésions des nerfs périphériques, dans les plaies de guerre. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1915, 3S., vol. xxxix, pp. 208-211.



- <sup>40</sup> Idem: Sur les formes douloureuses des nerfs périphériques. Soc. de neurol. de Par., July 1, 1915. Rev. neurol., 1914-15, vol. xxviii, pp. 726-728.
- <sup>41</sup> Idem: Les signes cliniques des lésions de l'appareil vasculaire dans les blessures des membres. Presse méd., 1916, vol. xxiv, pp. 153-156.
- <sup>42</sup> Mitchell, S. W., Morehouse, G., and Keen, W.: Gunshot Wounds and Other Injuries of Nerves. J. B. Lippincott and Co., Philadelphia, 1864.
- <sup>43</sup> Policard, A.: Un procédé simple d'étude direct de la circulation capillaire chez l'homme; la microangioscope. Compt. rend. Soc. méd. d. hôp. de Lyon, 1919.
- <sup>44</sup> Rocher, et Ferrand: Sympathectomie périhumérale; quatre observations ayant donné d'excellents résultats. Paris méd., 1918, vol. viii.
- <sup>45</sup> Sicard, J. A.: Traitement de la névrite du médian par l'alcoolisation tronculaire sus-lésionnelle. Bull. et mém. Soc. méd. d. hôp. de Par., July 9, 1915. Bull. et mém. Soc. méd. d. hôp. de Par., 1914, 3S., vol. xxxix, pp. 586-588.
- <sup>46</sup> Idem: Blessures de guerre; traitement de certaines algies et acro-contractures rebelles par l'alcoolisation nerveuse locale. Soc. méd. d. hôp. de Par., Dec. 17, 1915. Bull. et mém. Soc. méd. d. hôp. de Par., 3S., vol. xl, pp. 20-40.
- <sup>47</sup> Idem: Traitement des névrites douloureuses de guerre (causalgies) par l'alcoolisation nerveuse locale. Presse méd., 1916, vol. xxiv, pp. 241-243.
- <sup>48</sup> Sicard, J. A., Imbert, L., et Jourdan: Contribution à l'étude médico-chirurgicale des blessures des nerfs. Presse méd., 1915, vol. xxiii, pp. 59-62.
- <sup>49</sup> Sollier, P. A., Rose, F., et Villandre, et Chartier: Traité clinique de neurologie de guerre. Paris, F. Alcan, 1918.
- <sup>50</sup> Soubeyran: A propos de la stupeur artérielle. Bull. et mém. Soc. de chir. de Par., 1919, vol. xlv, pp. 910-918.
- <sup>51</sup> Soubeyran et Michon: Note sur un cas de contusion artérielle, stupeur artérielle, syndrome causalgique consécutif. Bull. et mém. Soc. de chir. de Par., 1918, vol. xlv, pp. 805-806.
- <sup>52</sup> Souques, A.: Synesthésialgie dans certaines névrites douloureuses; son traitement par le gant de caoutchouc. Soc. de neur., May 6, 1915. Rev. neurol., 1914-15, vol. xxii, pp. 562-566.
- <sup>53</sup> Thomas, A.: Le réflexe pilo-moteur dans deux cas familiaux de meralgie paresthésique. Paris méd., 1920, vol. x, pp. 422-425.
- <sup>54</sup> Thomas, A., et Valensi, L.: Le spasme artérielle dans la claudication intermittente du membre inférieur. Paris méd., Jan. 19, 1918.
- <sup>55</sup> Tinel, J.: Les blessures des nerfs, semiologie des lésions nerveuses périphériques par blessures de guerre. Paris, Masson et cie., 1916.
- <sup>56</sup> Tuffier: Paralysie d'origine ischémique traitée par la sympathectomie périartérielle. Paris méd., 1919, vol. xxxi, p. 63.
- <sup>57</sup> Idem: Contusion de l'épaule, paralysie totale de l'avant bras et de la main. Sympathectomie périsvasculaire. Bull. et mém. Soc. de chir. de Par., 1918, vol. xlv, pp. 1741-1746.
- <sup>58</sup> Viannay, C.: La stupeur artérielle. Bull. et mém. Soc. de chir. de Par., 1918, vol. xlv, pp. 1321-1323.
- <sup>59</sup> Villard, A. G. P.: De la sympathectomie périartérielle comme traitement des douleurs causalgiques, après les observations du centre neurologique militaire de la 8 région. Fac. de méd. et de phar. de Lyon, Année scolaire, 1920-21, No. 42, pp. 13-75.
- <sup>60</sup> Walther, C.: Note sur l'intervention chirurgicale dans les blessures des nerfs des membres par projectiles de guerre. Communication à l'Acad. de méd., 1914, 3S., vol. lxxii, pp. 255-258.
- <sup>61</sup> Idem: Sur l'intervention chirurgicale dans les lésions des troncs nerveux des membres par projectiles de guerre. Gaz. méd. de Par., 1914, vol. lxxxv, p. 243.
- <sup>62</sup> Weiss: Beobachtungen und mikrophotographische Darstellungen der Hautcapillaren am lebenden Menschen. Deutsch. Arch. f. klin. Med., 1916, M. 119, pp. 1-39.

# PERI-ARTERIAL SYMPATHECTOMY

AN EXPERIMENTAL STUDY

By EDWIN P. LEHMAN, M.D.

OF SAINT LOUIS, MO.

FROM THE DEPARTMENT OF SURGERY, WASHINGTON UNIVERSITY SCHOOL OF MEDICINE

THE treatment of a wide range of pathological conditions in the extremities by the removal of the sympathetic fibres situated in the wall of the artery supplying the part, was first suggested by Leriche in 1913.<sup>1</sup> In the years intervening up to the present time, he, his collaborators and others in France have contributed many papers on this subject. Most of these papers are clinical in nature, although mention of experimental work is made. The ideas represented by this school have not spread widely in other countries. In America, Halsted<sup>21</sup> alone reports a case that bears out Leriche's contentions. No conclusive experimental work has been reported. The present work was done in an attempt to prove a part of Leriche's contentions by an experimental study.

Leriche maintains that our knowledge of the peripheral sympathetic is inadequate. On the basis of numerous clinical observations he has built up a somewhat elaborate conception of the physiology of this portion of the autonomic system, a conception difficult to visualize because, as he frankly confesses, many elements are not clear even to himself. Briefly, his ideas may be summarized thus: (1) The sympathetic fibres distributed in the various tissues of an extremity are in a state of "balance" which maintains the normal functional conditions of blood-supply, secretion and so forth; (2) any "irritative" lesion in any part of this distribution—*i.e.*, the arterial wall, the nerve, the muscles, etc.—may result in a state of unbalance which will in turn result in circulatory, sensory or nutritional disturbances; (3) a complete break in the cycle of sympathetic influence together with removal of the "irritative" lesion will reestablish the normal balance. It is only fair to state that this summary is my own attempt to compress into a small and easily grasped form a large volume of scattered inferences. It may not approximate Leriche's own summary, were he to attempt one; and it is open to almost as many exceptions as the observations it covers. On the basis of this theory he has proposed and carried out the stripping of the adventitia of the brachial or femoral artery (with the intention of removing with it the sympathetic plexus therein contained, and of thereby breaking the chain) in such conditions as causalgia, "troubles reflexes," cedema, trophic ulcers and the skin changes following venous varicosities. His cases of causalgia and circulatory disturbance were largely the result of war wounds, where partial lesions of artery or nerve could be demonstrated. His results have not all been successful; but there has been enough improvement in numbers of cases to justify his hope that a new method of treatment has been devised.

It is not my purpose to review in detail the mass of these papers nor to

attempt a critical analysis of his theory on the basis of his case reports. That task could be assumed only by one whose clinical experience in these obscure conditions was as wide as that of Leriche himself. In this connection I may quote a paragraph from Carter,<sup>30</sup> whose experience covers twenty-three cases of true causalgia among 3000 peripheral nerve injuries. "Leriche's and Tenani's operations, or denudation of the associated arteries and veins of their sympathetic fibres as already described, are of no value in true causalgia, although they may be in certain cases of peri-arterial sympathetic neuritis. Tinel, Veyrassat and Schlesinger reported favorably upon its use; but Girou says that the causalgia of Weir Mitchell is not curable by this method, although another type, exclusively sympathetic, yields to the denudation of the peri-arterial sympathetic."

Leriche's papers, which contain detailed case studies, record numerous instances of these conditions treated by his vascular stripping operation. His reports show the following physiological effects. At the moment of stripping the exposed artery it becomes markedly constricted in the zone of damage so that the peripheral pulse is much diminished or even vanishes. The immediate result, lasting for several hours, is a diminution of blood-pressure and a lowering in temperature of the extremity. The secondary effects, becoming evident after several hours, consist in increases in blood-pressure and pulse-pressure and a rise in local temperature of 2 to 3° C. These effects are at their maximum for a few days and gradually diminish, to disappear between the fifteenth and thirtieth days. Leriche considers the secondary effects to be due to the absence of the vasoconstrictor impulses delivered through an intact sympathetic. Parenthetically it may be remarked that this idea is untenable unless one is to believe that all the vasoconstrictor supply to a part is present in the vessel at a high level, *e.g.*, in Hunter's canal. This is a difficult assumption to make in the face of our knowledge that certainly a large proportion of the autonomic to the vessels of an extremity is delivered to the sensory-motor nerve near its origin and reaches the vessel at various points in its course. Kramer and Todd<sup>4</sup> have established the anatomy of this distribution for the arm and Potts<sup>5</sup> for the leg. The latter may be quoted as follows: "From the anatomical facts herein stated, it follows that local damage to a large artery will injure the vascular plexus at the point of damage only, but will not account for changes produced in the vessel at a distance from the injured site." Todd<sup>2,3</sup> in studying the sympathetic effects in cases of cervical rib, expresses a like opinion. Whatever the theoretical basis may be, the possibility of testing out these physiological effects under experimental conditions was presented, and the attempt to do so forms the first section of this study.

An element of predominant practical importance was also presented. From the standpoint of common experience, by far the most important of the conditions cited are, of course, the chronic ulcers of so-called trophic or other etiology. If it were possible to accomplish healing of these ulcers by this relatively simple operation, a great addition would be gained to our resources

in a large and intractable group of cases. It seemed important therefore, as it had seemed indeed to Leriche, to establish the effect of sympathectomy on wound-healing. He mentions<sup>29</sup> an experiment on a rabbit in which the healing of wounds of the ear was studied after division of the cervical sympathetic. This procedure, of course, results in removal of the vasoconstrictor fibres and a hyperæmic ear. His experiment showed a distinct acceleration in the healing of a wound in the sympathectomized ear, together with marked differences in appearance between this wound and that in the control ear. In view of the practical importance of this particular point, a repetition of this experimental approach to the subject was also made.

The first group of experiments, then, consisted in the study of the circulatory effects in an extremity of Leriche's operation. Inasmuch as these effects are the result of changes in vasomotor tone, it was felt that temperature measurements would be a reliable index to the occurrence of the effects expected. No attempt is made to assume any absolute quantitative value for the measurements. Dogs were used and the femoral artery chosen for the operation. It required a considerable number of operative experiences before the stripping of the vessel could be done without tearing the musculature; and even thereafter, as will appear, there were failures. Observations of leg temperature were made either by training the dog to stand in an especially constructed calorimeter for twenty minutes or by inserting thermometers symmetrically in the two legs under aseptic precautions.

*Experiment I.*—Dog, male. Chosen for gentleness and tractability. Trained to stand with feet in calorimeters for twenty minutes at a time. Control readings of leg temperatures. July 11.—Right leg  $0.1^{\circ}\text{C.}$  warmer than left. July 13.—Legs same temperature. July 14.—Legs same temperature. July 15.—Nine A.M. Ether anaesthesia. Right femoral artery stripped. No constriction of vessel observed. Left femoral artery dissected out but not stripped. Both wounds closed with silk.

Readings. July 15.—Four P.M. Legs equal in temperature. July 16.—Wounds clean. Left  $0.1^{\circ}\text{C.}$  warmer than right. July 18.—Left  $0.1^{\circ}\text{C.}$  warmer than right. July 18.—Three-thirty P.M. Both wounds clean. Right femoral artery exposed and a small film of tissue over part of circumference could be removed. No constriction observed. Wound closed as before.

Readings. July 19.—Nine A.M. Left leg  $1.7^{\circ}\text{C.}$  warmer than right. July 19.—Three-thirty P.M. Left leg  $0.1^{\circ}\text{C.}$  warmer than right. July 20.—Left leg  $0.1^{\circ}\text{C.}$  warmer than right. July 22.—Three P.M. Legs equal in temperature. July 22.—Four-twenty P.M. Ether anaesthesia. Right wound reopened. Marked inflammatory reaction but no pus. Artery resected from upper margin of stripping to a point 1 cm. below lower margin of stripping.

Readings. July 23.—Left leg  $0.8^{\circ}\text{C.}$  warmer than right.

*Experiment II.*—Dog, male. Calorimeter method. Less easily trained than dog in Experiment I. After considerable preliminary training the following control readings were obtained. August 1.—Left leg  $1.1^{\circ}\text{C.}$  warmer than right. August 18.—Left leg  $0.8^{\circ}\text{C.}$  warmer than right. August 19.—Left leg  $1.7^{\circ}\text{C.}$  warmer than right. November 10.—Left leg  $0.4^{\circ}\text{C.}$  warmer than right. November 14.—Left leg  $1.0^{\circ}\text{C.}$  warmer than right. November 16.—Ether anaesthesia. Right femoral artery stripped. No constriction of artery observed. Wound closed with silk. No wound made in left leg.

Readings. November 17.—Right leg  $0.1^{\circ}\text{C}$ . warmer than left. November 26.—Wound open, but clean. Legs equal in temperature. November 30.—Ether anaesthesia. Laparotomy, two cm. of right abdominal sympathetic resected.

Readings. December 2.—Right  $1.7^{\circ}\text{C}$  warmer than left. December 5.—Right  $1.4^{\circ}\text{C}$ . warmer than left. December 8.—Right  $1.7^{\circ}\text{C}$ . warmer than left.

Further experiments of the same sort were attempted, but in these instances the effort to strip the relatively small vessel completely resulted in such damage as to necessitate ligation of the vessel. This, of course, rendered the animal, highly trained and of a disposition not common among laboratory dogs, unfit for further experimentation. A large amount of time and effort were wasted in this way. For that reason, the more direct measurement of subcutaneous temperature by thermometers was adopted. Delicate thermopile records did not seem indicated, inasmuch as only marked differences in temperature would be of significance.

*Experiment XXVI.*—Dog, male. June 14.—Three-fifteen P.M. Ether anaesthesia. Thermometers placed in the subcutaneous tissue in symmetrical positions in each lower leg. Readings for fifteen minutes showed equal temperatures in the two legs within  $0.1^{\circ}\text{C}$ . Three-thirty P.M.—Both femoral arteries exposed. Right femoral stripped for 2 cm. of as much adventitia as could be obtained. No constriction observed. Both wounds closed. Readings for ten minutes after close of operation showed left leg  $0.3^{\circ}\text{C}$ . warmer than right. Thermometers out and small skin openings sutured.

June 15.—Wounds clean. One-fifty P.M.—Ether anaesthesia. Thermometers placed in untouched region about knee-joint in each leg. Readings showed approximately equal temperatures, the right leg  $0.2^{\circ}\text{C}$ . warmer than the left. Two P.M.—Laparotomy and excision of right abdominal sympathetic. Wound closed. Operation concluded at about two-thirty P.M. Readings for fifteen minutes showed right leg  $1.5^{\circ}\text{C}$ . warmer than left. Killed with ether. Post-mortem demonstrated removal of right abdominal sympathetic almost to diaphragm.

*Experiment XXVIII A.*—Dog, female. June 26.—Ether anaesthesia. Three-thirty P.M.—Thermometers placed as in Experiment XXVI. Readings showed equal temperatures in the two legs up to 3:45 P.M. Three-forty-five P.M.—Both femoral arteries exposed. Right artery stripped. No constriction noted. Both wounds closed. Operation finished at 4:05 P.M. Readings for fifteen minutes showed left leg  $0.2^{\circ}\text{C}$ . warmer than right.

June 27.—Wounds clean. Two-fifty-five P.M. Ether anaesthesia. Thermometers placed in undamaged region about knee-joint. Readings for fifteen minutes showed left leg  $0.1^{\circ}\text{C}$ . warmer than right. Legs each about  $2.0^{\circ}\text{C}$ . warmer than on previous day. Three-ten P.M.—Laparotomy. Excision of right abdominal sympathetic. Considerable bleeding from branch of vena cava. Wound closed at 3:35 P.M. Readings for fifteen minutes thereafter showed right leg  $1.8^{\circ}\text{C}$ . warmer than left. Killed with ether. Post-mortem demonstrated removal of right abdominal sympathetic.

Several experiments were also done to check abdominal sympathectomy alone without the preliminary femoral stripping. This experiment is, of course, a classical one. It was performed rather to establish roughly the quantitative relationship under the experimental conditions of the present study than to demonstrate the presence of a vasodilation in the corresponding leg. The protocols of two of these experiments follow:

*Experiment XXV.*—June 13.—Dog, male. Ether anæsthesia. Thermometers placed symmetrically in subcutaneous tissue of inner surface of each lower leg. At start of experiment right leg was  $1.0^{\circ}\text{C}.$  cooler than left. Laparotomy and resection of right abdominal sympathetic as high as about the mid-dorsal region. Readings on the legs for twenty-five minutes thereafter showed right leg from  $0.8^{\circ}\text{C}.$  to  $1.0^{\circ}\text{C}.$  warmer than the left, a net gain of about  $2.0^{\circ}\text{C}.$  Killed with ether. Post-mortem demonstrated removal of sympathetic.

*Experiment XXX.*—Dog, female. July 13.—Ether anæsthesia. Thermometers placed symmetrically in subcutaneous tissue of lower legs. At start of experiment right leg was  $0.4^{\circ}\text{C}.$  to  $0.5^{\circ}\text{C}.$  warmer than left. Right abdominal sympathetic removed to diaphragm. Fifteen minutes later, difference in temperatures of two legs was unchanged.

July 14.—Ether anæsthesia. Wounds clean. Thermometers placed symmetrically near region of knee-joints. After fifteen minutes observation a difference was obtained which remained constant for fifteen minutes longer. Right leg  $1.8^{\circ}\text{C}.$  warmer than left, a net gain of about  $1.5^{\circ}\text{C}.$  (This animal was then used for the study of healing of wounds as described later).

In the study of these protocols two facts stand out. (1) It is impossible to reproduce experimentally on dogs the circulatory changes described for human beings following the stripping of the adventitia from the main artery to a part. (2) These changes occur in the dog's leg following demonstrable removal of the vasoconstrictor fibres to the part. These results added to the anatomical consideration already discussed, make it seem highly improbable that Leriche's secondary effects are actually due to the removal of vasoconstrictor fibres. What they may be due to, it is difficult to surmise. Certainly he does not mention the possibility that the mere operative wound might increase local temperature on the affected side. We are all familiar subjectively with the local heat of a finger suffering from an extensive laceration even when it is healing kindly. If it be infected, we observe a much more marked increase in temperature. The following experiment was therefore performed:

*Experiment XXXV.*—August 7.—Dog, female. Ether anæsthesia. Three P.M.—Thermometers introduced subcutaneously in right and left legs, Symmetrical positions.

Readings	Right	Left
3:05 P.M.	$36.2^{\circ}\text{C}.$	$36.1^{\circ}\text{C}.$
3:10 P.M.	$36.2^{\circ}\text{C}.$	$36.2^{\circ}\text{C}.$

Three-fifteen P.M.—Right femoral artery dissected free. Not stripped. Wound closed with silk. Large branch of femoral vein accidentally torn and ligated.

Reading	Right	Left
3:25 P.M.	$36.1^{\circ}\text{C}.$	$36.2^{\circ}\text{C}.$

August 8.—Wounds clean. Ether anæsthesia. Two-fifty-five P.M.—Thermometers introduced subcutaneously in right and left legs. New symmetrical positions.

Readings	Right	Left
3:00 P.M.	$36.8^{\circ}\text{C}.$	$35.8^{\circ}\text{C}.$
3:05 P.M.	$36.9^{\circ}\text{C}.$	$36.0^{\circ}\text{C}.$
3:10 P.M.	$36.7^{\circ}\text{C}.$	$35.8^{\circ}\text{C}.$

Here we see an increase of almost a degree in the temperature of the leg that underwent a simple dissecting operation over that of the unoperated leg. It is to be noted also in Experiment II, that the operated side after stripping of the vessel showed a gain of a fraction of a degree over the unoperated side. This gain was increased by a full degree or more when the abdominal sympathetic on that side was removed. In this experiment no wound was made on the control leg. The gain in the operated leg in the first step of the experiment approximates that in the experiment just quoted. Although these results are by no means conclusive, they suggest a partial cause for findings of Leriche.

In the second group of experiments the sympathetic in the neck of a rabbit was divided and at the same time wounds of equal size were made in symmetrical position on the two ears. These were marked out with a cork-borer, in order to be certain of equal size, and the skin alone was stripped off. The following day observations were made of the presence or absence of the sympathectomy syndrome—namely, the contracted pupil, advanced nictitating membrane and hyperæmic ear. The progress of healing of the wounds was followed from day to day. In a few instances the vagus was divided in the search for the minute sympathetic. These experiments are recorded in those instances in which the syndrome of sympathectomy was present. Four experiments with wounds on the ears of dogs and one with wounds on the leg are also included. Typical protocols for experiments on both dog and rabbit follow.

*Experiment XXI.*—Rabbit—Ether anaesthesia. June 7.—Right cervical sympathetic dissected from vagus and divided. Wound 1 cm. in diameter made with cork-borer in corresponding positions on dorsum of each ear. June 8.—Evident vasodilation, right ear. Right pupil smaller than left. Nictitating membrane further advanced on right than left. Wounds dry and clean. June 10.—Wounds clean. Equal size. June 12.—Wounds equal in size. June 14.—Wounds equal in size. June 15.—Right wound slightly smaller than left. June 16.—Contraction well under way. Right still slightly smaller than left. June 17.—Approximately equal in size. June 18.—Wounds about 2 mm. in diameter on each side. June 19.—Both wounds healed.

*Experiment III.*—Dog, male. July 20.—Ether anaesthesia. Division of left cervical sympathetic. Thoracic duct injured. Wound 1 cm. in diameter made in corresponding positions on dorsum of each ear. July 22.—Nictitating membrane advanced one-third across left globe. Left pupil much smaller than right. July 25.—Neck wound discharging. Probably a lymphatic fistula. Ear wounds clean. Left somewhat smaller than right. July 28.—Left ear wound slightly smaller than right. August 1.—Contraction rapid. Left wound still slightly ahead of right. Neck wound healing. August 3.—Right, 2 mm. in diameter. Left, healed.

Of experiments that showed the typical syndrome for cervical sympathectomy, four were done on the dog and thirteen on the rabbit. The results are summarized in the following table. These wounds required about two weeks for healing. In no case was there a difference in favor of the hyperæmic side of more than forty-eight hours in healing time. In two instances there was a difference of several days in favor of the control side, but this

could be explained by incidental damage such as from too free use of the depilatory solution in preparing for operation.

<i>Table I.</i> —Animal	(1)	(2)	(3)	(4)
Dog	1	1	0	2
Rabbit	1	3	7	2

Column (1)—Experimental wound healed by forty-eight to twenty-four hours more rapidly than control wound. Column (2)—Experimental wound healed twenty-four hours or less earlier than control wound. Column (3)—Both wounds healed on same day. Column (4)—Control wound healed twenty-four hours or more sooner than experimental wound.

The single experiment on the leg of the dog was performed on the animal used in Experiment XXX. This dog had had an abdominal sympathectomy on the right side with a proved increase in temperature of the right leg of 1.5°C.

*Experiment XXX (continued).*—July 14.—Thermometric readings of temperature of legs as noted in first protocol of Experiment XXX. Wounds of equal size about 1.5 cm. x 0.5 cm. made in uninjured portions of each leg in corresponding sites. July 24.—Abdominal wound and subcutaneous wounds for thermometers healed cleanly. Experimental and control wounds clean and equal in size. Measure 0.4 cm. by 0.2 cm. July 26.—Both wounds healed.

In none of the entire series of experimental and control wounds was there observed any constant difference in the appearance of the two wounds. The granulations were not more hyperæmic in the wound on the sympathectomized ear. Furthermore, the period of contraction of the two wounds coincided in almost all instances as the table indicates.

These experiments do not successfully repeat those mentioned by Leriche. They must be interpreted as being quite negative in showing any effect on wound healing of a vasodilation consequent to the removal of the sympathetic supplying the region of the wound.

#### CONCLUSIONS

(1) "Perivascular sympathectomy" of Leriche does not result experimentally in the dog in the physiological changes in the extremity described by him in clinical cases.

(2) Vasodilation resulting from proved total sympathectomy does not affect wound healing.

Note.—Following the completion of the first group of experiments here reported, I encountered an incidental reference to experimental work by Leriche.<sup>23</sup> No further description of these experiments was found. He says: "Experimentally I have not obtained any results of interest. The large vessels of the dog do not contract after stripping."

In addition, through the courtesy of personal communications from Dr. David C. Straus and Dr. A. E. Halstead, I am informed that three perivascular sympathectomies have been performed by these surgeons in clinical cases. Doctor Straus in speaking of his two cases adds "Both cases showed Leriche's 'physiological effects.'" These cases were reported before the Chicago Surgical Society, November 3, 1922.

#### BIBLIOGRAPHY

- <sup>1</sup> Leriche, R.: De l'élongation et de la section des nerfs périverculaires, etc., Lyon Chir., vol. x, 1913, p. 378.
- <sup>2</sup> Todd, T. W.: Blood-vessel Changes Consequent on Nervous Lesions, Jour. Nervous and Mental Diseases, vol. xl, 1913, p. 439.



- <sup>3</sup>Todd, T. W.: Indications of Nerve Lesions in Certain Pathological Conditions of Blood-vessels, *Lancet*, May, 1913, vol. i, p. 1371.
- <sup>4</sup>Kramer, J. G., and Todd, T. W.: The Distribution of Nerves to the Arteries of the Arm, *Anatomical Record*, vol. viii, 1914, p. 243.
- <sup>5</sup>Potts, L. W.: The Distribution of Nerves to the Arteries of the Leg, *Anat. Anzeiger*, vol. xlvii, 1914, p. 138.
- <sup>6</sup>Leriche, R.: De la Causalgie, etc., *Presse Med.*, vol. xxiv, 1916, p. 178.
- <sup>7</sup>Leriche, R.: De la Causalgie, etc., *Rev. Neurologique*, vol. xxix, 1916, p. 184.
- <sup>8</sup>Gaskell, W. H.: The Involuntary Nervous System, 1916.
- <sup>9</sup>Leriche, R., and Heitz, J.: De la Réaction Vasodilatatrice, etc., *Comptes Rend. de la Soc. Biol.*, vol. lxxx, 1917, p. 160.
- <sup>10</sup>Leriche, R.: De la Sympathectomie Péri-artérielle, *Presse Med.*, vol. xxv, 1917, p. 513.
- <sup>11</sup>Leriche, R., and Heitz, J.: Des Effets Physiologiques de la Sympathectomie périphérique, *Comptes Rend. de la Soc. Biol.*, vol. lxxx, 1917, p. 66.
- <sup>12</sup>Veyrassat, J. A., and Schlesinger, A.: Du Traitement du mal perforant, etc., *Rev. Med. de la Suisse Romande*, vol. xxxvii, 1917, p. 63.
- <sup>13</sup>Leriche, R., and Heitz, J.: Influence de la Sympathectomie, etc., *Comptes Rend. de la Soc. Biol.*, vol. lxxx, 1917, p. 189.
- <sup>14</sup>Leriche, R., and Heitz, J.: Resultats de la Sympathectomie, etc., *Lyon Chir.*, vol. xiv, 1917, p. 754.
- <sup>15</sup>Stopford, J. S. B.: Thermalgia (Causalgia), *Lancet*, Aug., 1917, vol. ii, p. 195.
- <sup>16</sup>Girou, E.: Causalgies et Syndromes Dououreux d'origine Sympathique, *Press Med.*, vol. xxvi, 1918, p. 584.
- <sup>17</sup>Stopford, J. S. B.: Trophic Disturbances in Gunshot Injuries of Peripheral Nerves, *Lancet*, Mar., 1918, vol. i, p. 465.
- <sup>18</sup>Leriche, R.: Notes sur la Causalgie et sur son Traitement, *Lyon Chir.*, vol. xvi, 1919, p. 531.
- <sup>19</sup>Leriche, R.: Sympathique Périverneux et Eczéma Variqueux, *Lyon Chir.*, vol. xvi, 1919, p. 651.
- <sup>20</sup>Leriche, R.: Effets de la Sympathectomie Périthyroidienne Supérieure, *Lyon Chir.*, vol. xvii, 1920, p. 109.
- <sup>21</sup>Halsted, W. S.: Elevation of Temperature of Hand following Excision of Subclavian Aneurism, *Bull. J. H. Hosp.*, vol. xxxi, 1920, p. 219.
- <sup>22</sup>Leriche, R.: Des Effets de la Sympathectomie Péricarotidienne interne Chez l'homme, *Presse Med.*, vol. xxviii, 1920, p. 301.
- <sup>23</sup>Leriche, R.: Méningite séreuse corticale enkystée post-traumatique. Epilepsie Jacksonienne. Trépanation après sympathectomie péricarotidienne dans un but d'hémostase, *Lyon Chir.*, vol. xvii, 1920, p. 392.
- <sup>24</sup>Leriche, R.: Traitement de Certaines Ulcérations Spontanées des Moignons, etc., *Presse Med.*, vol. xxviii, 1920, p. 765.
- <sup>25</sup>Lewis, D., and Gatewood, W.: Treatment of Causalgia, *Jour. Am. Med. Ass'n*, vol. lxxiv, 1920, p. 1.
- <sup>26</sup>Abadie, C.: Sympathectomie Péri-carotidienne, *Presse Med.*, vol. xxviii, 1920, p. 606.
- <sup>27</sup>Leriche, R.: Nature des Ulcérations Trophiques, *Lyon Chir.*, vol. xviii, 1921.
- <sup>28</sup>Leriche, R.: Some Researches on the Periarterial Sympathetics, *ANNALS OF SURGERY*, vol. lxxiv, 1921, p. 385.
- <sup>29</sup>Leriche, R., and Haour, J.: Du Mode d'action de la Sympathectomie Périarterielle sur la Réparation des Tissus et la Cicatrisation des Plaies, *Presse Med.*, vol. xxix, 1921, p. 856.
- <sup>30</sup>Carter, H. S.: On Causalgia and Allied Painful Conditions Due to Lesions of Peripheral Nerves, *Journal of Neurology and Psychopathology*, vol. iii, No. 9, 1922, p. 1.

# ALUMINUM-POTASSIUM NITRATE IN THE TREATMENT OF SUPPURATIVE CONDITIONS, PARTICULARLY OSTEOMYELITIS

BY MAX THOREK, M.D.

OF CHICAGO, ILL.

THE World War brought forward many advances in the treatment of infectious processes, both from the viewpoint of improved surgical technic, and also the pre- and post-operative treatment by means of improved antiseptics, greatly facilitating the surgeon's work, and in many cases rendering surgical intervention unnecessary.

All of the accepted methods, however, included the use of an antiseptic or germicidal agent, chief of which were the iodine and chlorine derivatives, the earlier simpler mercurials and phenols having been practically discarded. Many highly organized organic compounds, such as diaminomethyl acridinium and its chlorides (acriflavine) have been investigated and proposed in the effort to reach the desideratum—that of low toxicity and high germicidal index free from effects tending to delay or inhibit the natural regenerative processes.

The writer's experience in the management of infected cases closely parallels that of most surgeons with the comparatively small proportion of satisfactory results compared to those obtained in other fields of practice, and a considerable portion of time has been diverted to the observation and investigation of the cultural, non-antiseptic, aluminum-potassium nitrate method. A preliminary report upon which is herewith presented.

In the selection of a definite line of investigation, we are at once confronted by two diverging paths—one leading along the well-beaten track of antiseptics including the employment of a germicide specific to the organism known to be present—the other pointing to the "antibody" method by which natural processes within the body tend to eliminate the invading or infecting organism. This latter path was followed, paralleling in many ways that of vaccine and serum therapy, *with the one striking difference that the "antibody" is developed in the original host instead of being transplanted and evolved in an animal.*

The aluminum-potassium nitrate compound method of treatment is the direct development of observation of the meat preserving industry where the so-called "brine" containing potassium nitrate is employed as the oxidizing agent. A number of cases were treated with successful end results, using potassium nitrate alone, but it was found to produce great irritation and sloughing of tissues, together with maceration of surrounding normal tissues, all of which rendered its use alone almost prohibitive. The potassium nitrate action seemed to be cumulative, reaching the maximum in about ten to fourteen days, with its attendant irritation. Reduction of the dosage, while

decreasing the irritation, also reduced the reaction to such a degree as to be of little value. It became evident at this point that some modifying agent must be added which would admit of maximum reaction with a minimum of irritation. Many combinations, covering a great variety of salts, were tested out, and it was found that aluminum nitrate, astringent and non-irritant itself, seemed to have the property of inhibiting the pain, yet not interfering with the oxidizing properties of the potassium salt when combined in a dressing of low aqueous content, but had the drawback of falling apart in aqueous solution, again permitting the potassium element to exercise its irritant and macerative properties. Research was continued in the direction of finding a non-aqueous solvent to obviate this condition, and at the same time other experiments were carried on with a view of introducing a third element to stabilize the combination of the other two. Finally a compound was prepared by crystallizing aluminum nitrate and potassium nitrate from concentrated nitric acid which does not cause hydrolysis of the aluminum nitrate. The quantity of aluminum nitrate and potassium nitrate used should be in the proportion of the molecular weight of one molecule of aluminum nitrate to three times the molecular weight of one molecule of potassium nitrate. For example, 375 grains of aluminum nitrate and 303 grains of potassium nitrate in sufficient hot concentrated nitric acid to dissolve the substance will produce a solution from which the double salt  $\text{Al}(\text{NO}_3)_3 \cdot 3\text{KNO}_3 \cdot 10\text{H}_2\text{O}$  will crystallize out on cooling and after drying the product it contains approximately 31 per cent. aluminum nitrate, 44 per cent. potassium nitrate and 25 per cent. water of crystallization. About 500 c.c. of concentrated nitric acid, kept hot by means of the water bath, is a suitable quantity of acid in which to dissolve one kilo of aluminum nitrate and potassium nitrate mixed in the proportions previously indicated. The described salt crystallizes from the concentrated nitric acid solution in the form of colorless rhombic and monoclinic crystals. They are readily soluble in cold or warm water in substantially all proportions. They possess an astringent slightly metallic taste. This product is further diluted with nine parts of potassium nitrate and the resultant mixture is incorporated in the dressing used in the treatment.

#### BACTERIOLOGICAL EXPERIMENTS

The nature of the infection in individual cases was determined by culture and subsequent plating and the relative number of organisms determined by direct smear from the exudate of the lesion. In the greater number of cases a mixed infection was found, staphylococcus aureus predominating. In many of the foregoing a Gram positive organism was present of saprophytic type. A small percentage of cases showed a pure culture of short chain streptococcus. It is of interest to note that in none of the cases diagnosed clinically and radiographically as tuberculous osteomyelitis were tubercle bacilli found on examination of the excretion. Staphylococcus aureus or a sterile fluid was invariably present. Examination of the smears before and during treatment show a marked increase in the number of colonies progressing with the course of

treatment and only decreasing in number and finally totally disappearing in the terminal cycle of treatment.

In an endeavor to determine the germicidal index of the aluminum-potassium nitrate compound, many experiments were carried out with the final conclusion that instead of possessing antiseptic and germicidal powers, *it actually assists and intensifies the growth of bacteria when added to the culture media.*

A uniform suspension of bacteria well distributed through diluted bouillon when introduced into media containing various percentages of the aluminum-potassium nitrate compound solution, showed growths varying from two to five times those found in the untreated media. These results were found constant in a large number of laboratory experiments.

#### ANIMAL EXPERIMENTS

The toxicity or rather non-toxicity of the aluminum-potassium nitrate compound was tested first on guinea pigs, then on rabbits and finally on monkeys (*Macacus Leoninus*) by the intravenous, subcutaneous and oral routes. The results in all instances show that the aluminum-potassium nitrate compound is entirely non-toxic, irrespective of its method of administration. Two large monkeys weighing 42 and 45 pounds, respectively, were given single intravenous injections of 80 grains each, and later the same amounts introduced intra-abdominally and intra-muscularly without the least untoward effect. The same animals were at the same time fed two ounces each of the salt each feeding. No loss of weight or decrease in activity or function could be noted. The intravenous and subcutaneous doses in these experiments were over double the average amount used *externally* in the treatment of human patients.

#### CLINICAL MANIFESTATIONS UNDER TREATMENT

In chronic cases of osteomyelitis of many years' standing, with sinus formation, where there has been only a thin serous discharge, which under the microscope shows a few epithelial cells and an occasional leukocyte, there appears within twelve to twenty-four hours after application of the dressing, a marked purulent discharge containing innumerable polymorphonuclear leukocytes and tissue shreds, although no reaction is apparent on the skin. This indicates that in these twelve to twenty-four hours, some element from the dressing must have passed into the deeper tissues to produce this acute reaction calling forth an increased leukocytosis expressed in terms of the pus discharge.

Dialyzation through the skin may be further observed by inserting a tube into the sinus, sealing same to the surrounding skin and observing the volume and character of the discharge. After this observation, a dressing of aluminum-potassium nitrate compound is applied, and a comparative observation made, when it will be noted that there has been a tremendous increase

in the volume, and a great change in the character of the discharge, which now consists almost entirely of leukocytes and débris.

If the dressing is discontinued, the discharge will immediately subside, and within a few days will resume its original amount and character. This conversion of a thin serous fluid into a purulent discharge can be due only to an acute reaction within the tissues, producing a rapid autolysis and liquefaction of the diseased area. This liquefaction and autolysis is produced first by the influx of leukocytes and phagocytes, and second by the nascent oxygen acting on the diseased tissues without affecting the normal. The nascent oxygen is probably derived by the splitting of the nitrate ion in its passage through the skin into the deeper tissues. Nascent oxygen does not alter normal healthy tissue, but the infiltrated tissues which are contaminated with organisms are affected by the aluminum-potassium nitrate compound, accounting for the selective action of this compound in attacking only the diseased structures.

The vesicle and pustule formation is probably the result of stimulation of the latent bacteria into marked activity by the aluminum-potassium nitrate compound which has been proven experimentally to be an excellent culture medium. Some of these pustules seem to connect with the deeper tissues. Fine probes have been passed through the skin pustule into the bone cavity.

Clinically, we are not able to produce a reaction beyond the area of disease or the point of infiltration of the soft tissue. In the case of a small area of osteomyelitis in the middle third of the femur, with an infiltration of the adjacent soft tissues, a dressing applied over the entire length of the femur will not produce a typical reaction in the skin, and no vesicles or pustules will appear beyond the affected or infected areas. The aluminum-potassium nitrate compound is apparently selective in its action because it produces no reaction where no organisms are present. This reaction apparently definitely outlines the area of infection. The vesicles and pustules show culturally in practically every instance the same organisms that are isolated from the deeper tissues.

In every case a hyperplasia of blood-vessels in the treated area is noted, evidenced both by the active hyperemia, and also from the histologic study of sections of deep tissues taken at the time of operation, many of which were done for the removal of large sequestræ.

Another observation of importance is the increasing bacterial count of the exudate during the initial period of treatment due to the application of a cultural dressing tending to stimulate the dormant bacteria of a chronic state into activity, reducing their virility and vitality in proportion to the increased rate of propagation, and at the same time increasing the resistant elements of nature by a local leukocytosis and phagocytosis in much the same way that natural forces deal with an acute infection.

In almost every case a marked improvement in the general physical condition of the patient is noted almost at once, making it seem that the aluminum-potassium nitrate compound was absorbed and had produced a direct systemic effect. Extensive investigation has not been able to support this theory, and

on the other hand, investigations by Professor Kahlenberg of Wisconsin University, failed to disclose any traces of either base in the blood or urine. Continuous observation of this effect, together with the constancy of the condition leads me to believe that the systemic reaction is more apparent than real, and is the result of a rapid autolysis producing local exudation at the site of the lesion where prior to institution of this treatment absorption had obtained, carrying the toxins through the system and imposing an abnormal load on the organs of elimination. The aluminum-potassium nitrate compound treatment

simply maintained the case within localized limits permitting the eliminatory organs to resume their normal full functions without this excess load.

#### TECHNIC

The technic of application consists in applying a plastic dressing directly to the affected area, made up of a vehicle into which the aluminum-potassium nitrate compound is incorporated. Ordinary rolled oats has been used for this purpose, and it has been suggested that same be sterilized for two hours in an autoclave, under about fifteen pounds pressure, for the purpose of destroying the proteolytic enzymes, which would otherwise



FIG. 1.—Cutaneous reaction in aluminum-potassium nitrate therapy.

tend to invert or sour it, besides introducing various other bacilli, tending to complicate the microscopic picture. Should an autoclave not be available it is suggested that practical sterilization of the rolled oats can be accomplished by heating for twenty to thirty minutes in an ordinary oven. Rolled oats is suggested as meeting the best average of the ideal requirements of availability, cost, cellular structure and, above all, being physiologically inert, thereby eliminating the irritant properties of many other available materials. The vehicle is made by adding approximately 50 c.c. of boiling water to the ounce of dry rolled oats, and stirring until a uniform mass is produced, after which

the aluminum-potassium nitrate compound is added and thoroughly mixed through. Experience has shown that the average dose is approximately thirteen grains of the aluminum-potassium nitrate compound per ounce of dry rolled oats. The dressing is applied about one-eighth of an inch thick directly to the skin well beyond the limits of the affected area, and is covered over with some waterproofing material such as wax paper, gutta percha, etc., in order to retain the moisture. This is an important procedure, which, if omitted causes the dressing to solidify and to become hard and shrink away from skin contact. This dressing should remain in absolute contact with the skin continuously and be changed *as often as it becomes saturated with the exudate*, and in any case should be changed at least once in thirty-six hours, on account of loss of moisture to tissues. No gauze should be interposed between dressing and skin.

The definite dosage for individual conditions cannot be accurately plotted, as the individual peripheral nerve sensitivity largely governs the limit of nitrate content, excesses expressing themselves by burning sensations. The safe and rational clinical procedure would be to start with a relatively small

dose and gradually increase it to the point where irritation appears, and then reduce it slightly below that point. This amount may be as low as five grains per ounce and may run as high as forty grains per ounce, varying with individual sensitivity and also with the part of the body treated.

It is of interest to note that an aqueous solution of aluminum-potassium nitrate compound applied in a non-plastic vehicle, such as a gauze pack, does not produce any of the typical reactions or effects of the above described procedure, but on the contrary induces a cessation of all reactions and promotes a rapid epithelization of the abraded surfaces resulting no doubt from imperfect skin contact retarding dialyzation.



FIG. 2.—Cutaneous reaction in aluminum-potassium nitrate therapy.

*Reaction.*—The typical reaction manifests itself within about forty-eight hours with the appearance of an erythema very much like that of an erysipelas, and this is followed within a few days by vesicles and pustules over the affected area (see Figs. 1 and 2) containing purulent fluid, many of which continue to discharge after rupture, presenting the umbilicated appearance of a small-pox lesion without the crater and bluish edge. This definite reaction continues as long as the infection in the underlying tissues persists. The dressings become saturated with exudate, which renders them ineffective, at which time they must be renewed. A good practice is to change the dressings at least once in twenty-four hours.

The area of reaction during the course of treatment gradually reduces in size even though the original area is still being treated. This is perhaps an indication that the area beyond is free from the infecting organisms. This unusual and peculiar reaction in the case of chronic infections, both of soft tissue and bone, seems to be due to the passage through the skin and into the deeper tissues of some of the elements of the aluminum-potassium nitrate compound.

*Indications.*—In the course of several hundred cases treated successfully by this method, over one-half were of the mixed infection type with staphylococcus aureus predominating. One-third of all the cases cultured staphylococcus aureus alone, and the balance including streptococcus, pyocyanus and saphrophytes. The lesions treated included osteomyelitis, both traumatic and hæmatogenic, bone tuberculosis where secondary infection was established, furunculosis, various post-operative wound infections, and some forms of gangrene.

This method of treatment was found to be contraindicated in the presence of malignancies because of the greatly increased local vascularity which seems to accelerate their growth.

#### CASE REPORTS

*Tuberculosis of the Spine.*—Male, twenty-four years of age, Polish. Admitted to the hospital August 10, 1922, with a diagnosis and typical manifestations of acute appendicitis (pain at McBurney's point 15,000 leukocytes, high temperature, tenderness, etc., in right lower abdominal quadrant). Appendectomy; usual technic, Battle-Kammerer incision. Appendix found inflamed, thickened, not containing pus.

Operation did not afford relief, patient continuing to complain of vague pains, heightened temperature and general malaise. X-ray examination of kidney and ureter as well as of hepatic region proved negative.

Aluminum-potassium nitrate compound was then applied over the entire right side. Within four hours a definite area of fluctuation was manifest, which ruptured spontaneously the following day, discharging thick pus, which yielded in culture an almost pure strain of staphylococcus aureus. The area of reaction extended to the lower dorsal spine and a stereoscopic radiogram, made at this time, disclosed a beginning tuberculosis of the first lumbar vertebra.

In this instance the aluminum-potassium nitrate treatment not only afforded excellent relief from pain by instituting prompt local drainage, but, which is more important, pointed the way to an obscure and unsuspected lesion. The treatment



was continued for four weeks more, when the patient left the hospital very much improved. He presented himself a month later for examination. The improvement in his condition progressed very favorably, and the patient returned to his usual vocation of a rather strenuous type within a month after the aluminum-potassium nitrate treatment was started.

*Osteomyelitis of the Humerus.*—Male, thirty-four years of age, American. Observation began April 14, 1922. At that time, the left arm was found very much swollen, painful to touch and motion, both active and passive, and a marked contracture at the elbow. Wassermann negative. Physical examination disclosed nothing of importance, other than the condition of the affected extremity. Radiogram showed an active infectious process, affecting over one-half of the length of the entire humerus, with considerable destruction and evidences of early operative intervention (curettements?). The surrounding soft structures were hard and infiltrated; no fluctuation; scars resulting from previous operative procedures red and angry looking.

Treatment with aluminum-potassium nitrate compound was commenced, changing the dressings every twenty-four hours. After the initial application, a marked softening was discovered overlying the affected area, surrounded with a general hyperæmic blush of the contiguous surface. During the succeeding forty-eight hours, many pustules appeared, discharging pus. At this time, the pain had entirely disappeared from the affected limb; contracture of the joint considerably lessened. After seven days of treatment a remarkable regression of the affected process was apparent, the arm being at this time about normal in size, with full return of function at the elbow. Pustules along the margin of the old scar continued to discharge a small quantity of pus, while those in the areas beyond disappeared under the same dressings.

Patient returned to his work, continuing the daily dressing. About three weeks later he returned, at which time no further reaction could be produced. No definite sinus developed in this case, drainage has evidently been accomplished by capillary absorption. Six months later an examination of the patient discloses him to be in perfect health, the arm to all appearances normal. There is no return of the symptoms and clinically at least the patient is to be considered cured.

*Osteomyelitis of the Tibia.*—Female, single, twenty-four years of age, American. Anamnesis discloses nothing of importance as far as family history is concerned. Patient states that she observed about three years ago, sharp intermittent pains in the right knee, which pains after a few weeks became continuous. Diagnosed by family physician as rheumatism and treated as such for a month. This was followed by an abscess below the knee, which the attendant opened and irrigated. Pain did not subside and fixation in plaster case was resorted to. Two months later the case was removed, but incision had not healed. Wide curettement of the tibia was then done, followed by three more similar operations at three-month intervals. Wound has remained open over three years with much destruction of the upper third of the tibia. Physical examination disclosed a rather poorly nourished individual. Urinary findings showed much indican and a slight trace of albumin. Wassermann negative.

The affected limb was subjected to the aluminum-potassium nitrate treatment for ninety days, applications were made daily, after which time the patient was discharged with sinuses healed. Two months later the patient presented herself for examination. No recurrence of objective manifestations can be noticed and subjectively the patient feels well. Patient gained in weight, is in better spirits and looks upon life with greater cheer. Radiogram made at the last examination shows prolific regeneration of the tibial defect.

*Post-operative Suppuration in Abdominal Wall.*—Female, fifty years of age, Austrian, came under observation with suppurative sinuses in abdominal cavity following laparotomy.

Usual treatment instituted by attending physicians without results. Attempts to heal the sinuses by the usual methods proved unsuccessful.

Aluminum-potassium nitrate treatment instituted. The day following the first application the drainage tubes which were left *in situ* were removed. The volume of discharge increased many times, necessitating changing of dressings every four hours. Six days after the beginning of treatment the upper sinus had healed by granulation and three weeks after treatment began the patient was discharged with both sinuses completely healed.

*Osteomyelitis of the Femur.*—Male, thirty-four years of age, Hungarian, presents himself with all classical manifestations of osteomyelitis.

The history reveals a condition that had been persistent for sixteen years, during which time at least eight or nine curettements had been done, and more than a couple of dozen incisions for relief of abscesses, which had burrowed in various directions. During the past five years the affected limb was never free for one month without discharging pus in some place. Amputation was seriously considered by his attendant; Wassermann negative.

Physical examination disclosed nothing of importance, other than objective and subjective findings of the affected limb. X-ray shows extensive destruction of the lower third of the femur, without tendency to regeneration. There is apparent absence of periosteum from the epiphysis to about the middle of the femur.

Aluminum-potassium nitrate treatment was instituted. Within a few hours after the first application the drainage became so profuse that dressings had to be changed every three or four hours. Five days later several small spiculæ of bone worked their way to the surface and they were lifted out with tissue forceps. At this time the dressings were changed thrice daily. Three weeks after treatment was instituted dressings were changed only once a day. The discharge at this time was markedly serous in character.

X-ray studies made a month after treatment was commenced showed a comparatively clear outline of the femur with beginning osteogenesis at the edges of the defect. The patient was able to note a complete closure of the sinuses, a disappearance of objective and subjective manifestations, three months and four days after treatment was commenced. A subsequent examination, two months later, shows no symptoms that might indicate any recurrence. These findings checked up with X-ray studies disclose progressive new bone formation.

*Osteomyelitis of the Radius.*—Female, nineteen years of age, American, presents forearm disclosing suppurative sinuses, the result of an open operation for Lane plating for fracture of the radius, the result of a fall. Plate had been removed some time after the operative area disclosed signs of infection. A plaster-of-Paris cast had been applied and antiseptic dressings were made through a large window cut in the plaster-of-Paris. A radiogram shows good apposition of fractured fragments, and a small quantity of spongy callus feebly attempting repair.

Aluminum-potassium nitrate treatment was started and continued daily for thirty-four days, at the end of which time the sinus was found healed. With the exception of a week at the hospital the rest of the treatment was strictly ambulatory. Two months later the X-ray examination disclosed new-formed callus welding the broken fragments. Patient has full use of the arm.

*Osteomyelitis of the Foot.*—Male, fifty-eight years of age, Bavarian. History discloses that patient had suffered from diabetes mellitus, for which he remained under his physician's strict care.

## TREATMENT OF OSTEOMYELITIS

Physical examination disclosed a fairly well-nourished individual. Wassermann negative. Urinalysis with reference to sugar and albumin negative. His left foot disclosed that two toes had been amputated. A suppurative sinus at the distal end of scar tissue resulting from the amputation which exudes a thin, watery serum. Foot is very much enlarged. Cutaneous circulation poor, foot livid in appearance, suspected of beginning of gangrene.

Radiograph shows absence of the fifth metatarsal and about half of the fourth, the distal end of which seems to be sloughing. Surgical removal of the remaining fragment of the fourth metatarsal bone was performed. Œdema did not subside and the aluminum-potassium nitrate treatment was begun. Four days after the commencement of treatment the swelling had receded over one-third of the area affected and within the period of a week it had entirely disappeared. Two weeks later the sinus had healed and the patient was apparently cured, but remains still under observation.

### CONCLUSIONS

That the treatment herein described is not in any degree a substitute for rational surgery, but must be considered as a pre-operative treatment in badly infected cases, enabling the surgeon to later work under more favorable conditions.

As a post-operative treatment in infected cases irrespective of whether the case was previously or subsequently infected.

As a procedure in those cases that have failed to respond to previous surgical measures and those patients who persistently decline operation.

Removal of sequestræ is in all cases advisable.

*The aluminum-potassium nitrate compound is not an antiseptic, but, on the other hand, is a definite accelerator of bacterial growth, tending by rapid propagation to lower the vitality of the infecting organisms thereby assisting the normal resisting powers of the body to eliminate the invading organism.*

Unlike most antiseptics, the aluminum-potassium nitrate compound does not attack normal tissues and does not interfere with granulation or the osteogenetic efforts of nature.

Pain, which in most cases, is the result of infiltration and consequent tension, is very quickly relieved, due to prompt autolysis and liquefaction relieving tension by absorptive elimination through sinus or systemic absorption.

Over 75 per cent. of our cases become ambulatory and are able to pursue their vocations, coming to the clinic for dressings in contrast to the radical surgical procedures of the past, thus eliminating long hospitalization and later invalidism with its attendant expense.

The method is relatively simple, may be used within wide limits, and employs a non-toxic medicament.

## CHOLECYSTOSTOMY VERSUS CHOLECYSTECTOMY

By J. CHRISTOPHER O'DAY, M.D.

OF HONOLULU, HAWAII

THE eternal fitness of things has ordained that all issues must be opposed before experience determines their actual values. As the advocates of an issue are the first to appear, and knowing, from the natural order of things, that opposition will be inevitable, it has become the conventional to create an impressive vehicle upon which the issue may be presented with dignity. Such vehicle has, usually, to do with either benevolence or altruism, and, where these may fail to fit with grace, the old *status quo* is pointed to as something very badly in need of improvement.

Prohibition, as set forth in the Eighteenth Amendment, is an example of what we have in mind, for there are good and honest men who are advocating it while other men equally as good and honest are opposing it. We know, however, that in spite of the arguments of each, or whether or no we will have prohibition the United States will continue being a great nation.

Coming now to the question suggested by the title of this paper, namely, *Shall We Drain or Remove the Gall-bladder?* We are aware that one adopting either procedure would not entail the risk of becoming a professional Damocles, yet we do, and too often, forget that ardor will warp whatever may become exposed to it, even to one's best judgment.

If we were enabled to compare the end results of ten thousand cholecystectomies with the end results of as many gall-bladders drained we might then be able to have more definite reasons for our particular view of the question. By end results let it be understood that a record of each of the cases of the two sets be accurately kept, the record not to be complete till the subsequent death permitted a post-mortem examination of the biliary and pancreatic mechanisms.

Nothing short of such a tabulation could possess much scientific value, and not until more reliable and accurate methods of compiling data have been insisted upon can we justify the privilege of becoming impatient with those whose views happen to run counter to our own.

Since the splendid work of Robson in 1900, and that of Maurice Richardson a little later concerning the relation of gall-stones to chronic interstitial inflammation of the head of the pancreas, and then later to have the lesson driven home by post-mortem findings as well as observing at operations damaging sequelæ that were traceable to a previous removal of the gall-bladder, the belief has taken hold of us that the removal of a gall-bladder, even though it be filled with calculi and highly infected, imposes a risk on the patient that none of us would be willing to assume.

During the early days of this controversy many able surgeons declared themselves unwilling to depart from the many virtues the tests of time had

shown belonged to drainage. Drainage, they emphasized, is the surgeon's greatest ally. But conservatism, like truth and modesty, as goes the world, but seldom attracts, and its voice, like that of the one crying in the wilderness, is too often unheeded.

With gall-bladder disease two dangers are omnipresent—dilatation of the bile ducts and cirrhosis of the head of the pancreas.

Chronic interstitial involvement of the head of the pancreas is not the result of bile having been regurgitated into the ducts because of an obstruction to the papilla of Vater. It is made possible by the contiguity of gall-bladder, gall-ducts, duodenum and pancreas alone. Its origin is in the gall-bladder, a gall-bladder infected and containing stones, and it was Richardson who showed how this hypertrophic pancreatic cirrhosis is always turned back when the gall-bladder is drained.

While it is not clear how this infection reaches the pancreas by the contiguity of structure, and why its effect is limited to the head of the gland, yet, insomuch as it is brought to a favorable termination by drainage of the gall-bladder we can do no less than conclude that toward the pancreas is a direction of least resistance over which the infection or its products find an avenue of easy escape. When this direction of least resistance has been reversed by the introduction of a drainage tube, repair of the pancreas may begin and go on without further interference from the invader.

The work of Mann and Giordano shows that bile is not a factor in the so-called chemical pancreatitis, and while this fails to coincide with the work we reported in 1904, we still believe that pancreatitis will result more quickly from pancreatic obstruction than when the obstruction is in the funnel of the ampule of Vater.

One of our cases of acute pancreatitis was caused by a calculus obstructing the junction of the ducts of Wirsung and Santorini. Primarily the case was operated on for what was believed to be an acute perforated gastric ulcer. The areas of fat necrosis together with the enormously swollen pancreas changed the diagnosis. The stone was found on post-mortem.

If, as Mann and Giordano have shown, bile is no factor in the cause of pancreatitis, then we must conclude from our own observations, that obstruction to the papilla of Vater will, where the duct of Santorini does not open into the duodenum, produce pancreatitis. Not because of the regurgitated bile but because of the obstruction to the pancreas itself. Such an obstruction will not act so quickly as the one obstructing the pancreas alone, because the dilution with bile together with a means of escape through the liver renders the action of the pancreatic secretion less virulent.

But to return to the original question of removing or draining the gall-bladder one great deception has been recognized. The baneful effect of removing the gall-bladder may not begin to show itself till several years have passed following the operation.

It has been argued that conservation of the gall-bladder is unnecessary in the securing of adequate drainage, for the reason that a tube may be fastened into the cystic duct when the gall-bladder has been taken away. This argument is very weak. It is not a question of drainage alone, nor is it a question of saving the gall-bladder. It is much bigger than this, it extends way into the future health and comfort of the patient.

If the fate of the gall-bladder was the only thing there was at stake, and it was known for a certainty that the function of the gall-bladder was of minor importance and that one really could get along as well without as with it, then there would be no question to settle. But the fate of the gall-bladder, of itself, is begging the question, for the gall-bladder has a function and when that function is destroyed either by disease or removal the whole biliary system must pay the price. Often the pancreas is taxed.

We have been able to find no record of a case of cirrhosis of the head of the pancreas where the subsequent contracture of the connective tissue caused obstruction of the pancreatic duct. This cannot be said of the common duct. While, as Richardson pointed out, a severe degree of fibrosis does not obtain in the head of the pancreas when drainage of the gall-bladder has been the method of treatment, we must bear in mind that even though it should occur, the presence of the gall-bladder will save the life of the patient through a cholecystoduodenostomy.

Occasionally the surgeon encounters what may best be termed the remnant of a gall-bladder. It has been obliterated by the ravage of infection. Its mucosa is gone and in its stead nothing but hard unyielding scar. It has the shriveled aspect which betrays the hopelessness of its state. There may still be one or more stones within the space that represents a part of the old lumen. It has been long since bile was admitted into it. When such a gall-bladder is met with we should first remember that such a remnant of a viscus gives rise to no symptoms, and should it have been pain complained of that led to the finding of such a gall-bladder its removal alone will fail the relief expected from the operation, a further search must be made. This is a case where disease has performed a cholecystectomy, and, were it possible to examine the biliary ducts at the time, the dilatation, which comes as a result of lost gall-bladder function, would be as distinct as when removed by the skill of the surgeon.

Unless it be plain that its function is irretrievably lost no gall-bladder should be removed, for it is well known and understood that the most desperate looking of them is restored to normal by drainage. We must permit ourselves to become impressed with the fact that when a gall-bladder has regained its function the biliary channels will likewise regain their normal tone and lumen.

The function of the gall-bladder is really composite. It has a chemical, physical and mechanical aspect, but as the art of the surgeon is a mechanical one, it is scarcely within the pale of his domain to discuss other than the mechanical function of the organs with which he comes to deal.

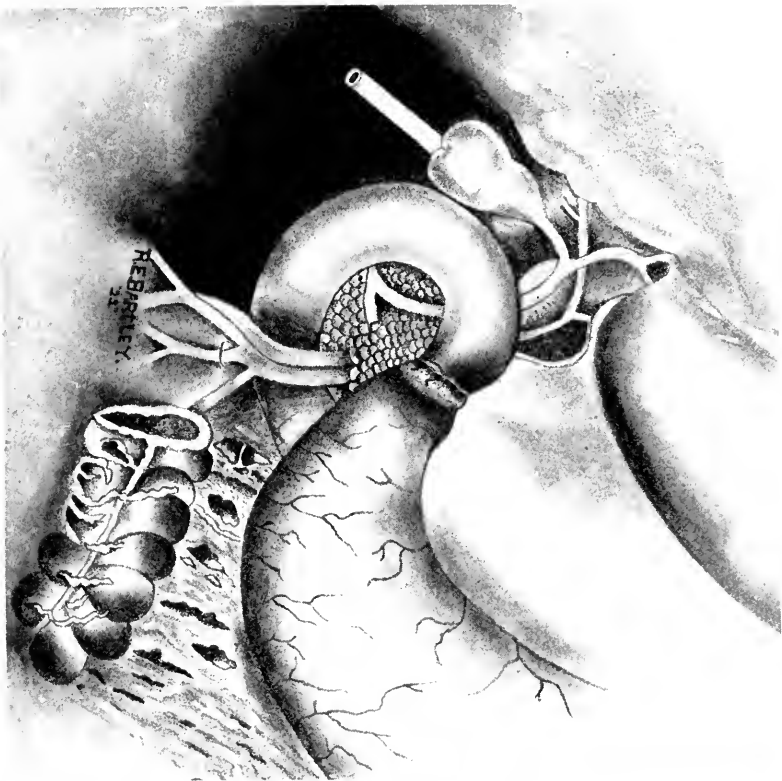


FIG. 1.—Note the difference in the size of the common duct above and where it pierces the pancreas and the narrowness of the conjoined opening of bile and pancreatic ducts. Conjecture the relief afforded by inserting the drainage tube into the gall-bladder. Note the manner in which the superior mesenteric vein and artery cross over the lower portion of the duodenum. A point in the anatomy, of uncertain importance, in certain types of psois. (Moynihan).



FIG. 2.—Showing the normal papilla of Vater within the duodenum. FIG. 3.—Showing how it is affected by cholecystectomy. The valve-like action is gone,—it is an unguarded opening into the liver.





## CHOLECYSTOSTOMY VERSUS CHOLECYSTECTOMY

We know that the dilatation of the bile ducts which comes as an afterclap to the removal of the gall-bladder is permanent. This alone should plead caution, because, once the valve-like action of the papilla has been rendered useless by such dilatation, ascension of infection will, by reason of the intra-abdominal pressure, sooner or later, give rise to a cholangitis that is capable of assuming any degree of severity. In one of our cases calculi were found beaded throughout the upper common and the hepatic ducts.

The mechanical function of the gall-bladder involves the same principle that makes an air-chamber a necessary part of a high pressure pump. The very same principle which enables the water-ram to lift water above the level of its source. What the compressed atmospheric air within the pump's air-chamber means to the system of pipes receiving the discharge of the pump, and what suddenly arrested velocity means to the functioning of the water-ram, intra-abdominal pressure and the elasticity of the gall-bladder mean to the discharging of the bile from the liver.

Any system of pipes, no matter how strongly put together, will sustain leaks unless the pump furnishing the pressure be equipped with an air chamber. The compression and the decompression of such air acts as a cushion upon which the shock of each pump thrust is absorbed. If instead of the rigid pipes a system of pliant tubes be used, then without an air-chamber dilatation of the entire system would ensue and continue till a breaking point had been found. Excepting the breaking point, this is precisely what happens when the shock-absorbing function of the gall-bladder has been destroyed.

## CHOLELITHIASIS, CHOLECYSTITIS AND CHOLANGITIS

By A. BELCHAM KEYES, M.D.

OF CHICAGO, ILL.

(LATE) SURGEON TO COOK COUNTY HOSPITAL

THAT the sequence of this subject be not broken, let us first briefly review the much written about question of (a) gall-stones and cholecystitis and then, the often much more important, allied (b) intra-hepatic conditions frequently concomitantly present.

*Intra-hepatic Stones.*—Considering the frequency of stones in the gall-bladder, one wonders that intra-hepatic stone formation is not much more common, than reported. (a) Being very small, intra-hepatic (bile-canal) stones are (probably aided by liver excursion) so easily washed downwards, via the ever enlarging bile-canals, to the still much larger ducts, that they are seldom encountered intra-hepatic at post-mortem examinations. (b) The greater distance from the infection within the intestines, the recency of secretion, and the almost continuous flow of bile make the formation of stones in the bile-canals less liable to occur. There are, however, many post-mortem descriptions in the literature of long, branched and cylindric intra-hepatic stones, with even extension downwards into the hepatic duct.

In the often quoted case of Chopart, the intra-hepatic stone-formation made it difficult to cut the "stony" liver at the autopsy.

*Stones in the Ducts.*—The conclusions are that: (a) Stones do not form in the ducts; (b) Hepatic duct stones are very probably always descending from the intra-hepatic bile-canals; (c) Cystic duct stones are usually from the gall-bladder, as are also usually common duct stones by "wandering" and failing to reach the intestine; (d) In rare cases cystic and common duct stones also, may be of intra-hepatic origin, must be conceded.

*Gall-bladder Stones.*—There are three possibilities: First, that very many small stones which have originated in the intra-hepatic canals, may descend into the gall-bladder and perhaps increase in size there. Second, that conditions present, may occasionally prepare the bile within the liver, for the formation of stones in the gall-bladder. Third, that gall-bladder stones are purely intra-cystic in origin, as a rule.

Gall-bladder stones occur as minute granules (gall-sand) alone, or as concretions of varying sizes, or as large stones only. The color varies, being alabaster-like, light or dark yellow, green, brown or black, gray or even white stones, according to contained pigment, chemical composition, or coating. The shapes were often green raspberrylike, especially if recent, spherical or oval if single; irregular, or faceted if multiple, due to pressure, friction, or other causes.

The number usually encountered by the writer was from one to thirty stones, varying in size from a millet-seed to small hen's egg. The writer has

removed over 2200, hundreds of others having been lost in the dressings from one case. The literature records cases with over 7000 stones.

A section of the liver in this case, removed at operation from just above the gall-bladder, proved microscopically to be carcinomatous. No intestinal malignant focus was discoverable.

The gall-bladders usually contained some slimy, often dark green or almost black bile; but bile with stones was occasionally almost or entirely absent, or a hydrops cystidis or an empyema of the gall-bladder was present.

*The Composition of Gall-stones.*—This is of the greatest interest, especially when considered with the causes predisposing and actual. (a) The most frequent gall-stone is of cholesterin and bile coloring matter, the alternating layers being lightly or more strongly stained with bile pigment. (b) Mixed stones, *i.e.*, a combination of the above with calcium carbonate, which usually formed a rough external coating, comes next in frequency. (c) Stones of entirely different chemical composition were often found together in the same gall-bladder.

*Rare Stones.*—(a) The pure translucent, alabaster-white cholesterine stone is very rare, they are usually very slightly colored with bile coloring matter. (The writer saw a pure translucent cholesterin stone the size of a pigeon's egg, removed from the gall-bladder by the late Doctor Mellish, late Surgery Instructor in Rush Medical College. It was whitish, very translucent, of very light weight, and had a very soapy feel. Recently an "almost" pure cholesterin stone the size of a large pea was shown me by Dr. E. Brougham of the Passavant Hospital.) (b) Pure pigment stones are described as dark green or black, homogeneous and very friable. The writer has never encountered one. (c) Pure calcium carbonate (chalk) stones are gray or white, hard, heavy, and usually rough. They are the most destructive and dangerous, and fortunately the most rare. (Both the pure calcium carbonate and the more common calcium carbonate coated cholesterin stone give an X-ray shadow.)

*Predisposing Causes. Age.*—Gall-stones are rare from infancy up to ten years. Three-fourths of one per cent. occur under twenty. The greatest frequency is after forty years of age.

*Climate.*—We have to consider the mode of life also, *e.g.*, in Norway 1 in 50, in Denmark 1 in 33, in Munich, Bavaria, 1 in 14 of all adults autopsied had stones in the gall-bladder. In the tropics where hepatic artery and portal vein liver (dysenteric, amœbic) abscesses are common, gall-stones are said to be rare.

*External Pressure.*—Corsets, kidney pads, belts, etc., by tightly pressing in the right hypochondrium, liver and gall-bladder, may kink the cystic duct and cause stagnation of bile. The "snared" liver from external pressure, so commonly reported in the European clinics as a cause of colic, was not encountered in a single case by the writer.

*Intra-abdominal crowding* due to tumor or pregnancy at-term are no doubt predisposing causes, but according to the writer's experience less

frequently so that the literature would lead us to suppose; yet it cannot be too much emphasized that gall-stones are common in women without and with tumors, with no family, small families, large families, in the lean and active, but more often in the inactive and fat, with shallow breathing, poor oxygenation and lessened liver excursion.

*Ptoses Are Probably Quadruply Predisposing.*—That a right floating kidney drags on the hepato-duodenal ligament, and not only kinks the ducts and causes (a) stagnation of bile, but is often also associated with wandering (Cantani's) liver, gastro-enteroptoses or general visceroptoses (Glenard), most common in multiparæ of spare habit, often resulting in (b) venous kinking and visceral engorgement, inviting (c) catarrhal gastro-enteritis, (Vater's) papillitis, with (d) possible ascending infection up the common duct.

*Chronic circulatory cardiac and pulmonary disturbances* such as mitral stenosis or regurgitation and also chronic pulmonary diseases are probable predisposing factors due to the venous engorgement. The lack of liver respiratory excursion especially in right-sided pleural or pulmonary disease is also a predisposing factor.

*Habits of Eating and Living.*—Hurried eating, irregular meals, over-eating and drinking, poorly cooked or too sweet foods, sedentary habits, poor ventilation and hygiene, are adjuvant predisposing causes. The overtired, poorly fed, coffee and buttered toast feeding. Internes in poorly ventilated hospitals are especially prone to catarrhal jaundice, while sailors on ocean-going sailing vessels were considered particularly free from gall-stones by the older writers.

*Certain acute and subacute infections, e.g.,* typhoid, or simple acute or subacute gastro-enteritis (the latter often almost symptomless) themselves or their sequelæ are predisposing.

*A catarrhal inflammation* of the duodenum no doubt always more or less involves Vater's papilla, and may ascend part way; or the whole length of the common duct (endoductitis communis); which with its inflammatory narrowing and increased *vis-a-fronte* to the gall-bladder "systole" and perhaps incomplete emptying of the same and stagnation of intra-cystic bile; may allow catarrhal infection to easily ascend (by continuity) up into the cystic duct (*endoductitis cysticus*) and thence to the mucosa of the gall-bladder itself (*endo-cholecystitis*).

Nomenclature should express in a word not only the site but the extent of an inflammation. The term cholecystitis alone is too inclusive and should be only used to express implication of the gall-bladder wall also, and pericholecystitis implication of the surrounding peritoneum.

*Prophylaxis.*—All glands whether salivary, mammary, biliary, pancreatic, renal, etc., resist ascending-continuity duct infections by the swift, free, downward flushing of their normal character and reaction gland secretion. The three important points then are (a) bile slowing, due chiefly to duct narrowing, (b) ascending infection, (c) excess of cholesterin present in bile under certain conditions.

(a) The normal gall-bladder systole and normal bile emptying protect the bladder and cystic and hepatic and common ducts, and thereby also the liver, from ascending cholangitis, and indeed the pancreas also; the duct of which latter occasionally opens a greater or less distance above Vater's papilla into the communis choledochus. As the common duct however in most sedentary people is probably more or less always a harbinger of bacteria, and narrowed; (b) the hypertrophied gall-bladder systole is very necessary indeed, to defend the cystic duct from the ascent of infection; for if the cystic duct once becomes infected the gall-bladder is certain to become so by aspiration, as the cystic duct is an affero-efferent duct.

(c) The real etiologic factor then in gall-stones formation, as well as in cholecystitis and cholangitis, is an ascending infection from the bowel to the gall-bladder, causing a precipitation of the bile salts, in which the larger quantity of cholesterin often present in the bile, probably plays an important rôle.

*There are four possibilities as to behavior of gall-stones—First*, if infection of the gall-bladder and ducts be not too severe, it can be recovered from before the precipitation of cholesterin, bile coloring matter or lime salts and the formation of gall-stones in the gall-bladder. The generally conceded idea that catarrhal icterus is followed by gall-bladder stone formation in every case, does not always hold good, because such an icterus may be due to infection and temporary complete atresia of the common duct only. If the cystic duct be still healthy the gall-bladder also remains healthy and no stones form. If, however, the infection reaches the affero-efferent cystic duct the gall-bladder will most certainly become infected and stones in all probability result.

*Second*: A "recovered" gall-bladder which to-day contains lots of bile and some mucus, and indeed some "duct passable" stones, is also probably capable of contracting, especially if hypertrophied, and emptying its slimy bile and nearly if not all of the stones, through the ducts, *i.e.*, if one can believe the histories of repeated typical colic attacks, in cases in which no stones were found at the operation, often to the consternation of both the diagnostician and surgeon, who too frequently place all of the operations-indication-importance on the finding of stones; and all too little on the often much more necessary drainage of the catarrhal gall-bladder and ducts, and possibly catarrhal intrahepatic bile canals; as will be explained later.

*Third*: The stones may remain and the gall-bladder and ducts so nearly recover after a severe gall-stone attack, that the patient may enjoy apparently normal health for years, often causing one for a time to question the diagnosis, and the stones be later an accidental discovery at celiotomy for some intercurrent disease or post-mortem; but as a rule after one attack, recurrent attacks occur sooner or later.

*Fourth*, the true relation of endo-cholecystitis without or with stones in the gall-bladder to possible hidden infection also of the intrahepatic bile canals (angiocholitis), should always be borne in mind.

*Spontaneous Gall-stone Colic*.—This deserves very careful description.

(a) The violent contractions of a simple catarrhal hypertrophied gall-bladder

forcibly driving its viscid duct-distending bile alone through infected and infiltrated ducts may possibly cause some bladder or duct pain. (b) Very small smooth stones may cause much pain in their passage through non-distensile, infection-stenosed ducts, due to stone pressure on inflammatory-infiltration crowded nerve endings in the duct mucosa. Small gall-stones also undoubtedly often pass through healthy ducts with little or no pain.

The most violent pain is said to occur as the stone passes through Vater's papilla, which being nearest the intestine may at first be the most infected and infiltrated; but as it is also situated easiest for early recovery, in some cases it may be the place of the least pain. The most violent pain ever seen by the writer was from an impacted stone in the first part of the cystic duct.

Pain persisting for a time after the apparent passage of a stone was common, probably from duct wounding or inflammation or perhaps occasionally from the wandering of still another stone.

(c) The very first attack of colic may be from the sudden wandering and impaction of a single very large stone, especially in the first part of the cystic duct, causing a continuous excruciating pain, and indeed possible cystic duct rupture if not immediately operated upon.

CASE 6079. J. B., age forty-seven. Cholecystostomy by the writer at the Chicago Polyclinic Hospital, assisted by Dr. Louis Rudolph. This patient had always led an active, abstemious life. The only stone found was a smooth, flat, oval shaped cholesterin-pigment stone of Spanish nut size impacted in the first part of the cystic duct. Recovery was uneventful and permanent. Doctor Rudolph recently reminded me that the gall-bladder also contained much blood.

(d) Occasionally one encounters one single hen's egg or larger sized stone, filling the gall-bladder completely, which may have been enlarging there for years, that had, according to the patient's history, never caused any spontaneous pain whatever. A painless case of this kind occurred in the writer's surgical service in the Cook County Hospital, in a woman sixty-three years of age. The rough, calcium carbonate coated cholesterin stone was the size and shape of a small pear. Quite possibly this was a faceted pyramid of cholesterin-pigment stones united by a coating of calcium carbonate.

(e) Lastly, the very first attack of spontaneous gall-stone colic may be that of a peri-cholecystitis or true peritonitis from either a wandering through infection or thrombo-arteritis and necrosis, or perforating ulceration of the gall-bladder wall.

CASE 6081. Mrs. H., age thirty-two, taken with sudden violent pain at 6 P.M. Operation performed at 9 A.M. on the following morning. There was already marked purulent infiltration of the surrounding adherent omentum. The gall-stones, dark, slimy bile and pus were very carefully evacuated and an iodoform gauze tail soft tube cholecystostomy drain placed in the anchored gall-bladder, and a cigarette drain in the adjacent peritoneal cavity. Recovery was uneventful and permanent.

This patient stated that she had never before had any pain in the abdomen in her whole life, as far as she could remember, nor any digestive disturbance further than a very occasional transient discomfort from indiscretions of diet, and until this attack had considered herself in perfect health. It might be

mentioned here that she was excessively fat. A second case of this character seen in consultation by Dr. Arthur R. Elliott also made a permanent recovery after operation.

*Pressure Pain.*—An actively catarrhal gall-bladder with or without stones can in rare cases be entirely devoid of pressure pain or discomfort over the gall-bladder region and yet be the cryptic cause of fever which subsides immediately after a cholecystostomy operation.

Before leaving the subject it might be as well to mention a few of the other right abdominal region colics, *viz.*, pneumonia, referred abdominal colic, pyloric and duodenal colic, snared, hydatid, abscesses, or carcinoma liver colic, inflammation, cystic or carcinomatous pancreatic colic, intussusception, obstruction, diverticulum, intestinal or appendicular (non-peritonitic or peritonitic) colic, paranephritic, nephritic ureteral or urinary-bladder colics, in the female para- and adnexal inflammation or tumor torsion colic—abdominal wall, neuralgia, herpes-zoster, Dercum's or epigastric lipoma or hernia colic.

These and others may have been mistaken for gall-stone colic on some previous occasion, indeed the finding of gall-stones by X-ray or in the fæces or at the operation, is not necessarily positive proof of their having been the cause of the previous colic attack. In *situs transversus* naturally gall-stone colic would be left-sided. Lastly, a true gall-stone colic or cholecystitis may, due to enlargement of the gall-bladder or ptosis, be diagnosed as one of the other colics.

*Wandering of Stones.*—This has been a matter of much speculation.

(a) Wandering seemed to occur most often in cases in which, due to more or less long standing common duct stenosis only, there had developed a marked hypertrophy of the gall-bladder musculature. The ducts have no musculature to aid in propelling stones.

(b) If a catarrhal endo-cholecystitis and the secretion of a large quantity of mucus occurs, this mixed with bile, makes a very slippery, viscid, duct dilating material, on which the contracting hypertrophic gall-bladder may easily make float, duct passable gall-stones into the cystic and perhaps the common duct, to wander entirely through, or perhaps become impacted.

(c) Wandering via the ducts, does not seem necessarily to occur because of the small size or number of the stones, for in first attack cases often only one large stone was found; unfaceted, that had become impacted in the upper third of the cystic duct. These gall-bladders were usually hypertrophied and contained much slimy bile, and occasionally some blood.

(d) Every surgeon has cases in which he has palpated many quite small stones in the gall-bladder, through a lower abdominal incision, in which there had never been any attack of colic, and perhaps indeed none occurred for years after the observation, especially if the patient drank copiously of Geneva or other alkaline spring water to keep the bile thin. Quite small stones in a "complete faceted pyramid" of a pear shape, completely filled the gall-bladder in one of the writer's cases; none apparently had wandered.

(e) Stones apparently do not usually wander where dilation and incom-

pensation of the gall-bladder have occurred, despite the excess of slimy bile; nor in cases with but little bile and marked atrophy or concentric hypertrophy of the gall-bladder.

(f) In cases of extremely large bladder stones, or complete atresia of the cysticus, duct-wandering is impossible.

*Wandering via fistulæ* is illustrated in a recently operated case, in which the gall-bladder and duodenum were so intimately adherent, that in opening what appeared to be the gall-bladder fundus between two tissue forceps, both bladder and gut were opened; reminds me to mention, that those extraordinarily large gall-stones that are occasionally evacuated from the bowel, undoubtedly have been passed via a bimucous gall-bladder-intestinal fistula at some inter-adherent point. At Cook County Hospital one lethal, intestinal obstruction at the ileocæcal valve occurred from a very large fecal stone supposedly of gall-bladder origin. These fistulæ may occasionally also open into other neighboring hollow viscera or indeed through the abdominal wall.

Intra-peritoneal perforation of duct and gall-bladder rupture is predisposed to by impacted stones in old, chronically inflamed friable ducts, and was encountered by the writer, especially in the first part of the cystic duct in five cases.

Rupture of the stone-containing empyemic gall-bladder itself, occurred in one case just before opening it, at its mid-posterior surface while gently raising the liver, with a flat retractor. A most conservative operation in this case resulted in uneventful, permanent recovery, the writer fearing that an extensive operation would result in death from subdiaphragmatic peritonitis.

A friable infiltrated gall-bladder wall is very often accidentally perforated with a sound, gall-spoon or finger, and such perforations are probably often mistaken for spontaneous rupture; but can usually be differentiated as operations-accidents by the absence or lightness of the adjacent peri-cystic peritoneal inflammatory changes present.

*Interpretation of Macroscopic Changes.*—These if considered immediately on opening the abdomen, in connection with the subjective-objective symptom-complex, often allow of a more correct surgical procedure. In recent years the hurried mechanical technic, and often misleading quotation of percentages, have all too often triumphed in popularity, over the careful, individual pathologic interpretation, and description of the behavior of cases which would tend to instruct the profession and improve the operations prognosis.

The adjacent peritoneum, if inflamed, whether punctate, circumscribed, or general; plastic, serous, or purulent; and also whether recent, or of long standing; by the firmness of the adhesions; although experience teaches us that adhesions may be very firm occasionally in cases of very recent symptoms.

Palpation of the gall-ducts for the presence of duct stones should always be done if possible before opening the gall-bladder, to avoid spreading intra-cystic infection, both into the greater, as well as (by the finger introduced into Winslow's foramen) into the lesser peritoneal cavity.

The unopened gall-bladder gives very important information as to the



different ducts. Simple acute dilatation of the normal gall-bladder by fresh bile, generally indicates a sudden, recent, acute stenosis or atresia of the common duct, with normal or nearly normal patency of the hepatic and cystic ducts, via which latter there is still a very free descent of bile from the liver to the gall-bladder.

Eccentric hypertrophy of the gall-bladder wall is liable to be found present if the common duct has been stenosed only moderately for a certain length of time, before the sudden very marked narrowing or atresia caused by the present exacerbation of inflammation. The cysticus and hepaticus are patent as in the previous case.

Icterus in normal gall-bladder cases with patent hepatic and cystic ducts occurs when a sudden *vis-a-fronte* stenosis communis has caused a dilatation and incompensation of the gall-bladder; or when the atresia communis is complete. If the cysticus alone becomes involved, icterus does not occur so long as the hepaticus and communis remain patent.

The reversal of the bile stream is possible if a marked gall-bladder hypertrophy has occurred, and then the complete atresia communis, by the contractions of the strong hypertrophied gall-bladder forcing its contents backwards via the still patent cysticus and hepaticus into the liver, increasing the intra-hepatic bile pressure and icterus, and indeed aid in causing an ascending cholangitis especially if the cysticus and gall-bladder be infected. Dilatation of the hypertrophied gall-bladder may result later.

Simple atrophy of the normal thickness gall-bladder generally points to a very early catarrhal implication and narrowing of the cystic duct; in this case from the onset of the disease, only a very small quantity of, or no bile from the liver can reach the gall-bladder.

Concentric hypertrophy occurs in cases in which a long standing, moderate stenosis of the common duct had already caused a hypertrophy of the gall-bladder wall. The cystic duct later became so narrowed as to make it impossible for much bile from the liver to reach the gall-bladder.

In a simple atrophy and concentric hypertrophy case icterus may be absent, if both the hepaticus and communis are widely patent, allowing bile to pass unhindered into the intestine; but as the bile has no longer the gall-bladder propulsion, icterus is at least theoretically liable if any communis narrowing whatever occurs.

While hydrops cystidis apparently most often resulted from an early simple atresia cysticus only, either from stone or a very low grade inflammation; an empyema of the gall-bladder usually resulted from primary acute ascending cystic duct inflammation or infection via intestinal adhesions. The adhesions as a cause of gall-bladder infection are probably more frequent than previously supposed.

The condition of the liver should be ascertained by inspection, palpation and if necessary aspiration with smears and cultures after each needle puncture.

The opened gall-bladder gives information as to contents, *viz.*: slime, stones, bile, hydrops or pus, and also to normal thickness or hypertrophy of the wall musculature and as to normal catarrhal or hyperplastic condition of the mucosa. From any of the above, important pathological deductions are possible, as well as indications in the operation.

*The Pancreas in Ductitis Communis Infection.*—The pancreatic duct also opens at Vater's papilla, or indeed occasionally very much higher up the common bile duct, so that any ascending infection of the common bile duct may be expected to occasionally result in a concomitant ascending pancreatic ductitis; therefore even an apparently slight gall-bladder case, often suffers also from inactivity of the pancreatic digestants and endocrines, as an additional cause of poor health, or indeed in certain types of bile-duct infection, perhaps the pancreas is equally or indeed much more infected than the ducts, gall-bladder or liver. In a case of clinical pancreatitis Dr. Paul Oliver very properly drained the gall-bladder, resulting in recovery.

*Indications in Operation.*—The chief indications in operations on the gall-bladder as a rule are often far greater for drainage of the cholangitic liver, and indeed the pancreas also, than they are for the drainage of the gall-bladder itself, and such drainage can only be accomplished by a cholecystostomy.

We certainly should hesitate and ponder carefully before performing cholecystectomy, since a cholecystectomy allows of but very imperfect liver drainage of the remaining passive bile pressure, only through the hepatic and common ducts.

These ducts, especially the common, are almost without exception infected and often markedly stenosed, and can drain themselves and the liver bile canals but very poorly and slowly immediately after the operation at the time when free (cholecystostomy) drainage is most necessary to insure recovery. By the removal of a good condition gall-bladder we are doing that which is physiologically contraindicated, *viz.*: mutilation. By the removal of a badly infected empyemic gall-bladder without or with pericholecystitis, we are often unable to avoid extensive manipulation, or the separation of very important circumscribing adhesions, thereby allowing the spreading of intraperitoneal infection, which being subdiaphragmatic is very liable to be lethal, due to the easy and rapid entrance of bacteria from the peritoneal cavity into the subdiaphragmatic lymphatics and even veins.

It is in both light and severe gall-bladder infections that rapid liver and indeed perhaps pancreas drainage also, is most urgently needed to effect a recovery, also many stomach and other symptoms clear that have resisted till then the most careful treatment.

*Cholecystostomy.*—That cholecystostomy should be in disfavor is not surprising when we consider the unsurgical methods often employed.

Thorough palpation of the ducts for possible duct stones should if possible be performed immediately on opening the abdominal cavity. This can be most easily performed through the short abdominal incision, by the operator standing on the left side of the patient and inserting the left index finger into

the foramen of Winslow. If no stones be found in the ducts the completion of the cholecystostomy operation can be performed without lengthening the incision.

After careful walling off with hot wet pads, aspiration, then apical opening and removal of all bile, mucus, hydrops or pus and stones from within the gall-bladder and first part of the cystic ducts. Diverticulæ should always be searched for. Extreme care should be taken to thoroughly explore the whole of the inside of the gall-bladder and diverticulæ with the index finger to insure the complete removal of all stones and pieces.

The insertion of a rubber tube only into the gall-bladder and purse-stringing it doubly and dropping the entubed gall-bladder back into the abdominal cavity is one of those procedures that has nothing to recommend it. It does not drain, it only permits of an overflow of stagnant bile, and should be abandoned because it allows of about four inches of bare tube for intestinal-omental adhesions to form around. These adhesions extend from the gall-bladder fundus upwards to the parietal peritoneum where the tube passes through the abdominal wall.

First. This stretch of adhesions is not a commendable operation—result functionally for either intestines or gall-bladder.

Second. Future accessibility of the gall-bladder is a very important necessity for both liver and pancreas and is made almost impossible by this procedure. In one case which came under my observation though operated elsewhere, the tube became loosened and the patient died of peritonitis.

*Parieto-Cystorrhaphy.*—The much more correct cholecystostomy operation is that in which the gall-bladder fundus is sutured to the parietal peritoneum.

If all of the stones are carefully removed and the cystic duct is or becomes patent, this operation, done properly, never resulted in a permanent fistula in any of the writer's cases.

After removal of all the gall-bladder contents as above described, the writer inserts a soft rubber tube through the abdominal wall opening into the gall-bladder. Through this tube, a long tail of iodoform gauze passes loosely, and with this tail, the gall-bladder is first packed to within one-half inch of the bladder fundus opening, into which latter the tube is now inserted. The gall-bladder and parietal peritoneum are united together by catgut sutures. The closure of the abdominal incision around the protruding tube and its gauze wick completes the operation.

This iodoform pack allows of some capillary drainage and impregnates the gall-bladder with an antiseptic applied directly to the gall-bladder mucosa, promoting early patency of the infected cystic and common ducts so that in many cases of hydrops and empyema cystidis, bile was already saturating the dressings within twelve hours.

That gall-stones will reform in the unremoved pathologic gall-bladder is always possible but is not necessarily a fact, but if stones do form they can be easily removed from an anchored gall-bladder. After operation the patient

needs careful instructions in diet, exercise, etc. Thus far among the cholecystostomies performed by the writer there have been no cases of recurrence of stones brought to his notice.

The consideration of the question of intrahepatic and pancreatic drainage for infections, so outweighs the question of the reformation of stones that in the opinion of the writer there is little room for discussion. One of the principal reasons why cholecystostomy fails in certain cases is that too early closure of the fistula occurs and the insufficient drainage gives only an abortive operative result.

*The Cholangitic Infections.*—The low grade ascending catarrhal common and cystic duct and gall-bladder infection is very often accompanied by a low grade cryptic hepatic duct and intra-hepatic duct infection or cholangitis. In many cases this cholangitis is entirely symptomless subjectively and objectively and has been so overshadowed by the more evident cholecystitis and gall-stones as to have been neglected. It certainly deserves closer study by the surgeon and diagnostician in life and by the laboratory workers, both in life and post-mortem.

If an acute exacerbation or extension of a fresh infection occurs, a rapid ascent by continuity upward from the ducts into the liver bile canals is always possible with the formation of multiple intra-hepatic foci of infection or indeed intra-hepatic abscesses, and death.

Death from the so-called "ptomaine poisoning" has occurred all too frequently of late years; often indeed without any diagnosis of the real cause of death if no autopsy was made; and indeed often when an autopsy was made; if there was found some slight focus like a broncho-pneumonic patch or other lesion to give as a cause of death.

Acute cholangitis often occurs suddenly in adult people, rich and poor, often indeed in the prime of life and apparently till then in robust health; demanding careful regulation of food sales and preparation and handling in eating houses, especially in these days of canning and cold storage preservation. The writer has had come under his observation recently five deaths, in some of which he has actually seen the microscopic sections, and while it was some satisfaction to have a laboratory post-mortem diagnosis, there is much need of awakening greater clinical interest and study of these cases, of which I give here the history of two.

CASE I.—A. I., age twenty-three, married, primapara, baby delivered (mid-plane), forceps by the late Dr. W. W. Jaggard. Anæsthetic A. C. E. mixture by the writer. The puerperium ran a normal course. The young, nursing mother had been up and about for three weeks in apparently normal health and one evening partook of a hearty supper of canned salmon, of which she was inordinately fond. That night violent abdominal pains, vomiting, chills, high fever and diarrhœa occurred. The urine was negative except for a very copious amount of urates.

Notwithstanding the history of the onset, the fact of having recently passed through childbirth caused among the well-to-do laity and friends, and even some of the unthinking profession, an unjust suspicion of puerperal sepsis, till

## CHOLELITHIASIS, CHOLECYSTITIS AND CHOLANGITIS

ruled out by pelvic examination by the late Christian Fenger. The autopsy performed by the late Dr. Stanley P. Black showed the cause of death to have been acute abscesses of the liver.

There were some slight evidences of an old appendiceal inflammation having occurred years previously, but showed no signs whatever of any recent activity; yet the vermiform appendix, which was under suspicion in those days as being the cause of so much abdominal trouble in young adults, was consequently considered the probable place of origin of the liver emboli.

The cause of death in this case was undoubtedly acute gastro-enteritis from canned salmon and ascending ductitis and angiocholitic abscesses.

CASE II.—P. B. Male, waiter, Greek, age thirty-two, always considered himself in good health until this attack. Admitted first to Alexian Brothers Hospital after eating "warmed up" soup at a first-class downtown hotel. Soon after eating he was taken with vomiting, violent pain in the pit of the stomach, diarrhoea, with frequently two or even three chills in twenty-four hours followed by temperature of 105° and over. From the history and a subjective and objective physical examination the writer was convinced that the man had an ascending infection of the liver or pancreas or both. The family removed the patient to the Passavant Hospital, March 31, 1915, and placed him in my care. Dr. Robert B. Preble in consultation agreed as to the absence of sufficient findings in the lungs, to cause the symptoms, and agreed to exploratory operation.

An exploratory operation was done, April 10, 1915, by the writer; vertical incision near the outer border of the right rectus muscle. Inspection, palpation and needling of liver, failed to locate pus. The gall-bladder contained much slimy bile only, but the diagnosis of possible ascending biliary hepatitis and abscesses of the liver was still adhered to. Cholecystostomy was performed by the opened gall-bladder being stitched to the abdominal peritoneum and iodoform gauze pack and tube drainage, which was promptly followed by a cessation of the chills and marked moderation of the fever temperature, which now ranged from 100° to 101°. Death occurred May 24th. Following each introduction of the needle, cultures should be made in these cases, as thus the diagnosis of biliary infection could often be made.

The autopsy revealed many Spanish nut to larger sized abscesses of the liver, showing that finding and draining one, two or three of the larger abscesses would be useless. The coroner's physician at a second autopsy confirmed the findings of liver abscesses, but despite this the coroner instructed the jury to bring in a verdict of death from pulmonary tuberculosis because of the presence of one small tubercular focus in the upper part of one lobe.

## CERTAIN ASPECTS OF SURGERY OF THE GALL-BLADDER\*

By OTIS F. LAMSON, M.D.

OF SEATTLE, WASH.

GALL-BLADDER surgery has passed through various stages of evolution to the present generally accepted operative procedure. Formerly, there was a tendency to extreme conservatism, and only very badly diseased gall-bladders were removed. Even when stones were present, the gall-bladder was drained and left intact. It was soon found that in a notable percentage of such cases stones and cholecystitis recurred, and the patient derived no benefits from the operation. Hence, secondary operations were not at all rare, and finally after a second or third ineffective operation, the gall-bladder had to be removed to relieve the patient. Such observations have led most surgeons to remove the gall-bladder, if feasible, at the first operation. Thus primary cholecystectomy came to be preferred to cholecystostomy. But so long as the true function of the gall-bladder remains a subject of controversy there will be discussion with regard to the better surgical procedure.

Since the early eighties various theories have been advanced regarding the part played by the gall-bladder in the scheme of the human machine. Some have believed it to be a vestigial organ like the appendix, whose usefulness belonged to a past period in the evolution of man; others believed it to be a reservoir in which the bile changed its chemical composition to some unknown quality better suited to promote the process of digestion. Others believed it to be a mere storehouse for bile, and therefore, capable of distending, without the knowledge of the individual, to many times its ordinary capacity. Dr. W. J. Mayo disputed this assertion on the ground that the gall-bladder with a normal storage capacity of one ounce, would be of very little use as a reservoir, since in twenty-four hours as much bile would pass through it as urine through the urinary bladder. If the gall-bladder is intended to hold such large quantities of bile, why is it that we find no special mechanism, no inherent propulsive power like that of the urinary bladder? The ejection of the contents must necessarily go on mechanically without interruption and at certain intervals, since an hour's secretion of bile is sufficient to fill this organ to its normal capacity.

There has been much controversy concerning the manner of expelling the bile. Ardent advocates of cholecystostomy attribute this process to the rhythmic contractions of the wall of the gall-bladder, and do not look farther for the cause of the distended organ than in the disturbance of this mechanism, and hope to overcome it by a drainage operation. In recent years it has been demonstrated that the force of the contractions of the gall-bladder

---

\* Presented before the Resident and ex-Resident Physicians of the Mayo Clinic, Rochester, Minn., May, 1922.

does not materially exceed the maximum secretion-pressure of the bile, and, therefore, is not sufficient for the task. The gall-bladder's function, it seems, is only to change the escape of bile into the intestines from a more or less continuous flow to an intermittent one.

Thus, at the present time, we are prone to believe that neighboring organs must assist greatly in the expulsion of the contents of the gall-bladder. Sweet and his followers assert, "The gall-bladder empties itself by the pressure of the liver and the distended stomach, during digestion, and by the milking action of the peristaltic waves that pass down to the duodenum."

Whether the gall-bladder empties itself or is emptied by neighboring organs, the fact remains that it must be emptied regularly, and experience has shown that we are unable to reestablish a lost function by temporary drainage operation. There remains no other procedure than to remove the organ, which, if once incapacitated, can be of no further use, and is likely to become a hotbed for all kinds of bacteria. Aside from the exit of bacteria into the duodenum, through the cystic duct, the organisms may be picked up by the abundant network of lymph channels in the deeper and superficial structures of the gall-bladder, and carried on to innocent adjacent organs. These lymph channels empty into two main vessels that communicate freely with the glands at the head of the pancreas. Therefore, cholecystitis may sooner or later be associated with pancreatitis.

Congestion of bile in the gall-bladder naturally promotes infection. When the wall of the gall-bladder in man is once infected and inflamed, it has little inherent resistance, owing possibly to its architecture and position, which make free and spontaneous drainage difficult. Infection also undoubtedly interferes seriously with its main function, namely its inherent influence on the flow of the bile. A diseased gall-bladder cannot contribute the something, possibly mucus, which plays an important part in the propulsion of its contents, especially when the cystic duct is of small calibre owing to inflammatory thickening of its walls.

When cholecystitis, with or without stones, is present, cholecystectomy, with perhaps a few exceptions, should be the operation of choice. I am convinced that in some of these cases, we are forced to depend largely on the clinical history of symptoms, besides examinations revealing definite tenderness over the gall-bladder area, rather than on the gross operative findings. "Interval" operations on gall-bladders without stones are most misleading; that is, when the acute attack has occurred two or three months before operation, and, through the natural resistance of the organ to disease, any gross evidence of disease has temporarily cleared up. Unlike the interval appendix operation, there is in many cases of cholecystitis without stones an absence of the telltale adhesions and thickening which follow acute appendicitis.

Thus, on examination there may be no thickening of the gall-bladder to palpation, no evidence of hepatitis, and no enlarged glands along the cystic duct, and yet there may be, lurking in the walls of the gall-bladder, an infection which will insure a recurrence of the typical gall-bladder attacks which

have caused the patient to consult his physician. It is not surprising that often the surgeon omits the radical operation on account of the lack of sufficient visible evidence of a diseased gall-bladder. Such patients invariably return, complaining of the same annoying symptoms for which they primarily sought relief.

I am convinced that a certain percentage of gall-bladders assume such a normal appearance between attacks, that it is practically impossible, from a gross examination of the organ during such intervals, to determine absolutely whether or not it is diseased. Fortunately, this percentage may be reduced by careful examination of adjacent and associated organs.

It is wise to bear in mind that when the gall-bladder is once infected it has little inherent resistance to overcome an infection and may become a hot-bed of bacteria. Illustrative of this is the typhoid carrier, in whom the bile in the gall-bladder and the wall of the organ itself are the fields which harbor typhoid bacilli for years. I have in mind a patient of this type, who had had typhoid fever about four years before she came under my observation as a carrier. She was a housemaid, and eleven cases of typhoid fever developed in the family in which she was employed. Typhoid bacilli were found in her stools on repeated examinations. I secured the coöperation of the health department, and she was instructed how to protect those about her from infection, and was told that she could not take a position; she was thus more or less isolated, and naturally very unhappy. I had a conference with Doctor Read, the Director of Health in Seattle, and it was decided to advise cholecystectomy, since we believed that the gall-bladder was harboring the organism. At first the patient refused operation, as she had not had any definite abdominal symptoms; but consented rather than to be deported as a menace to the community.

At operation the gall-bladder was found somewhat distended, and it contained several small stones. The gall-bladder and the appendix were removed. Bacteriologic examination of the bile showed that it contained typhoid bacilli. Examination of the stools three weeks after operation did not reveal typhoid bacilli, and on repeated examinations none were found. At the end of three months the patient was released as no longer a menace to the community.

This case again illustrates, in a small way, the inherent lack of resistance of the gall-bladder in overcoming infection, and the manner in which the bile may act as a culture medium in an infected gall-bladder.

It is interesting to note to what extent the gall-bladder will distend in some cases without rupture. I recall one case of stone obstructing the cystic duct in which the gall-bladder was fully 25 cm. long, and could be felt before operating in the right iliac region. In such cases it is reasonable to assume that the wall of the gall-bladder is not badly diseased at the time of obstruction; otherwise, it could not withstand such enormous distention without rupturing.



## SURGERY OF THE GALL-BLADDER

*Indications for Operation in Diseases of the Gall-bladder.*—Cases of acute or chronic cholecystitis, with or without stones, are essentially surgical. The time of operation must be decided in each case, depending on the patient's general condition. In many cases it is better to tide the patient over the acute attack until the severity of the infection has subsided. This procedure can not be followed in all cases however, as in the acute fulminating types, in which rupture of the gall-bladder is imminent, operation must be resorted to at once.

There are certain types of cases in which cholecystostomy may be the operation of choice: (1) when the general condition of the patient is so serious that it is unsafe to subject him to more than an absolutely necessary operative procedure; (2) when there is imminent danger of stricture in the common duct following operation, as in these cases it may be necessary to perform a cholecystoduodenostomy at a later date; and (3) in cases of common duct obstruction when jaundice has been longstanding with consequent impairment of the patient's health and coagulability of the blood is delayed and when the cystic duct is patulous and jaundice can thereby be relieved by drainage; hemorrhage in these cases is a serious complication, and by performing the least serious operation the danger is less imminent.

Except in the foregoing conditions, cholecystectomy should be the operation of choice, as in practically all seriously diseased gall-bladders, function is largely lost and we are only likely to be forced to the operation of removal at some future time, if the so-called more conservative operation of cholecystostomy is done primarily.

Complications that have followed operations on the gall-bladder and ducts have been varied. Injury to the hepatic and common ducts in clamping off the cystic duct has often been reported, resulting in biliary fistula or partial obstruction of the common duct from stricture. Surgery of the gall-bladder is apt to cause dense adhesions that may obstruct the pyloric end of the stomach or intestines and demand a secondary operation. I was once compelled to perform a gastro-enterostomy six weeks after cholecystectomy, on account of adhesions that almost entirely obstructed the duodenum.

The procedure of choice in operations on the gall-bladder is first to sever the cystic duct and work upward to the fundus; this method is described by Judd. In large thickened gall-bladders, or when adhesions are very dense, due to previous operations, it is necessary to work from the fundus toward the ducts.

## REMOVAL OF A RETENTION CYST FROM THE LIVER\*

BY JOHN F. X. JONES, M.D.

OF PHILADELPHIA

CASE.—M. P., a white, unmarried female, between seventeen and eighteen years of age (her mother stated that the patient was born September 24, 1904), was admitted to the Misericordia Hospital, May 10, 1921, because of a painful swelling of the abdomen. Two months previous to her admission the patient had noticed, for the first time, an enlargement of the abdomen. Thereafter, her abdomen increased rapidly in size and, at times, became so painful as to prevent her from attending to her usual affairs.

Three months before entering the hospital the patient had experienced (according to her statement) an attack of vomiting which lasted three days. With the exception of this one occasion there had never been either nausea or vomiting. There had been no irregularities of menstruation. Her abdomen had never been subjected to trauma. Neither family nor personal history suggested a possible cause for the existing tumor. The patient's appetite had been good and her bowel movements regular. There was but one subjective symptom—pain referred to the vicinity of the abdominal tumor.

On May 11, 1921, after having ascertained that her urinalysis was negative, her temperature  $98\frac{2}{4}^{\circ}$  F., her pulse 80 and her respirations 20, a physical examination was made of a well-nourished young woman who was about five feet in height and who weighed 124 pounds. Her sclerotics and skin were clear (here it may be emphasized that neither before nor after operation had there been jaundice in this case). Her teeth were in excellent condition; her tongue slightly coated; her tonsils had been removed. There were no alterations in the breasts; no skeletal changes. Her extremities were normal and of firm musculature. Investigation of the respiratory, circulatory and nervous systems was negative.

The abdomen alone seemed affected, and was so obviously abnormal as to focus the vision promptly upon an oval tumor projecting in the midline. The lower border of this tumor could be felt about one and one-half inches below the umbilicus, and apparently had no connection with the pelvis or the pelvic contents. Above, the tumor seemed lost under the transverse colon which I fancied I could percuss distinctly. I could not, however, feel the margin of the liver. Laterally, the tumor extended about three inches beyond the median line on each side. It could be moved very slightly from side to side; it could not be depressed; it could not be moved up or down. It fluctuated and was sensitive. The abdominal wall could be moved over the tumor. I was able to palpate neither spleen nor kidneys. I believed that I was dealing with an intraperitoneal cystic tumor, but I did not even suspect its connection with the liver. An exploratory laparotomy was decided upon.

The operation was performed under ether on May 13, 1921. From a point two inches above the level of the umbilicus to a point the same distance below the level of the umbilicus, a straight incision was made through the right rectus muscle. As soon as the peritoneum had been opened the summit of a large, grayish-white tumor appeared in the wound. This cystic mass having been partially delivered from the abdomen, I was able to feel a normal uterus with normal ovaries and tubes, to palpate the intestines beneath (behind) the tumor and to

---

\* Read before the Philadelphia Academy of Surgery, October 9, 1922.

## RETENTION CYST OF LIVER

outline the lower pole of an apparently normal right kidney. The hepatic origin of the tumor became apparent. The abdominal incision was enlarged upward to the right costal margin, when it could be clearly seen that the cyst sprang from about three inches of the sharp anterior margin of the left lobe of the liver. The gall-bladder apparently had never been inflamed, was easily compressed and contained no calculi.

In order to remove the cyst and its base it was necessary to excise a considerable portion of the anterior margin of the left lobe of the liver. Having walled off the underlying peritoneum from the liver by means of plain gauze pads, the anterior margin of the left lobe of the liver was compressed between four Péan hysterectomy clamps, two applied from each side of the left lobe. Both the proximal or upper two clamps and the distal or lower two clamps were applied, two from each side, in such a manner that their points crossed each other at a perpendicular line drawn through the centre of the anterior surface of the left lobe of the liver. The proximal or upper two clamps compressed the left lobe of the liver one and one-half inches above (behind) its anterior margin. The distal or lower two clamps compressed the left lobe of the liver one inch above (behind) its anterior margin. Then the left lobe of the liver was severed transversely by cutting through the liver tissue between the proximal or upper two clamps and the distal or lower two clamps. The distal clamps now held one inch of the excised anterior margin of the left lobe of the liver—or the base of the cyst—and the cyst; while the proximal clamps controlled the left lobe by reason of their position immediately above the cut surface of the liver.

The electric cautery was applied to the cut surface of the liver. Interrupted, interlocking, mattress sutures of number two chromicized catgut, doubled, were inserted through and through the liver tissue on the proximal side of the two remaining clamps. Not having at hand one of the needles especially devised for liver suturing, a large full curved needle, with round shank, was used, and the blunt (eye) end was inserted close to the clamps. The sutures were tied firmly but not tightly. Next, the clamps were removed. There was no hemorrhage. The abdominal wall was sutured in layers without drainage. Dr. J. Nall assisted. Miss S. G. Murphy anesthetized.

Immediately following operation the rate of the pulse increased to 148 and remained this rapid during the following day; on the 15th it slackened to 100; on the 16th it accelerated again to 140; on the 17th it was 100; on the 18th it was 80, where it remained. The day after the operation the temperature ascended to 101° F. where it remained for three days, when it returned to 98½° F. The respirations were 40 on the day after operation; 20 on the 15th; 28 on the 16th; 20 on the 17th and thereafter. Apart from these temporary irregularities of pulse, temperature and respiration, and with the exception of a transient albuminuria, which I believe was due to ether irritation, post-operative recovery was uncomplicated. On May 21, 1921, the stitches were removed by Dr. J. Hudock and healing was by first intention. On May 29, 1921, sixteen days following operation, the patient was discharged from the hospital.

When the patient was last examined, on July 21, 1922, over fourteen months following operation, there was no sign of recurrence of the cyst, the operation scar was firm, there was no evidence of hernia, the liver could not be palpated, the patient weighed 124 pounds, had no symptoms, subjective or objective, and was able to attend to all of her affairs without any inconvenience.

Following is the report of Dr. John D. Paul, the pathologist to whom the cyst was submitted for examination.

"The specimen is a grayish-white ovoid mass hanging from a pedicle. The mass fluctuates as though it contained fluid and measures 19 cms. in length and 10 cms. in its greatest diameter. When cut, the mass was found to contain 990 c.c.

of a dark greenish viscid fluid which gave the characteristic chemical reactions for bile. Cultures of this fluid were sterile after ten days' incubation. The remainder of the fluid was centrifuged and the sediment carefully examined for the presence of echinococcus hooklets, but none could be found. After opening the mass, the wall was found to consist of a very tough, thin, opaque material resembling fibrous tissue which was grayish-white on the outside and yellowish-brown on the inside.

"Microscopically (Fig. 1), this wall was composed of a thin layer of dense fibrous tissue lined on its inner surface with a single layer of low cuboidal epithelium. In many places, this lining epithelium had desquamated, leaving only the fibrous tissue wall; while, in other places, an occasional duct-like formation was found imbedded in the wall, suggesting the remains of small bile-ducts. Diagnosis: Retention cyst of the liver. This specimen was also examined by Dr. Allen J. Smith, who made the same diagnosis."

Dr. George D. Fussell, of the Misericordia Hospital, made a special examination of the portion of the liver removed with the cyst. Doctor Fussell's report follows: "The liver lobules are outlined by dense fibrous tissue. The liver cells are small and atrophied, the atrophy being most marked in the periphery of the lobules. The cytoplasm of the liver cells is pale; the nuclei are relatively larger than normal, but actually smaller and deep staining. The intercellular spaces are wide and contain many fibroblasts and fibrils of connective tissue. The fibrosis is especially marked about the vessels and ducts."

For the microphotograph of a portion of the cyst wall (Fig. 1), I am indebted to Dr. S. P. Reimann of the Lankenau Hospital.

Among those who have classified non-parasitic cysts of the liver are: Hanot and Gilbert (*Études sur les Maladies du foie*, Paris, 1888), Bland-Sutton (*Tumors, Innocent and Malignant*, 5th Ed., 1911), C. Langenbuch (*Chirurgie der Leber und Gallenblase*, *Deutsche Chirurgie*, Lieferung 45 h. 1897), J. Forbes (*Saint Bartholomew's Hospital Reports*, 1898, vol. xxxiii, pp. 181-227), F. Leppmann (*Deutsche Zeitschrift für Chirurgie*, 1900, vol. liv), E. Schwartz (*Chirurgie du foie*, 1901, cited by Fieschi), B. Kilvington (*Intercolonial Medical Journal of Australasia*, 1902, vol. iii), C. B. Blackburn (*Transactions of the Pathologic Society of London*, 1904, vol. 1v), Rolleston (*Diseases of the Liver, Gall-bladder and Bile-ducts*, 2nd Ed., 1912), D. Fieschi (*La Clinica Chirurgica*, Milano, 1909, vol. xvii), Tuffier (*Bull. et mém. soc. de chir. de Paris*, 1912, vol. xxviii) and Sidney Boyd (*The Lancet*, London, April 5, 1913, vol. i).

The writings of these authors have led me to believe that non-parasitic cysts and non-parasitic cystic formations of the liver may be divided into: 1. Teratomatous or embryomatous cysts. 2. Pseudocysts. 3. Lymphatic cysts. 4. Cystic degeneration of the liver with cystic kidneys. 5. Cysts which arise from blood-vessels. 6. Cystadenoma. 7. Ciliated epithelial cysts, and 8. Retention cysts.

1. Meckel's case of "dermoid cyst of the liver" has been cited by Hanot and Gilbert, C. Hoffmann (*Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie*, Jena, 1902, B.X), Leppmann and C. Langenbuch. The last-mentioned writer says: "Dermoid cysts, which of course are congenital in origin, can develop in the liver—at least Meckel reports, from the dissection

75

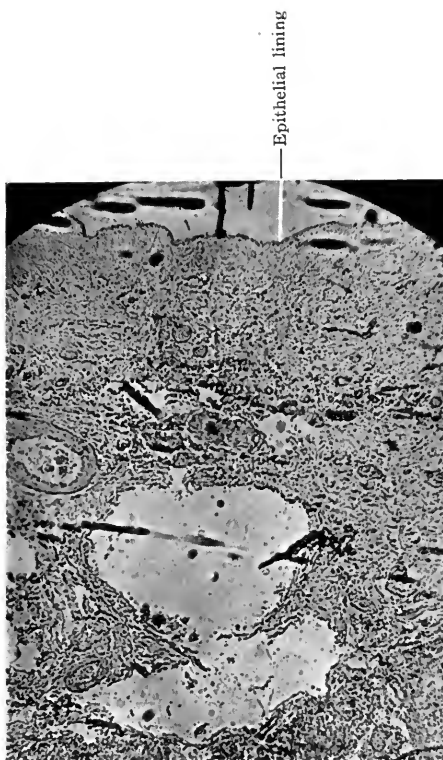


FIG. 1.—Microphotograph of portion of wall of cyst removed from the liver.



of a dropsical man in whose liver was found a cavity filled with cartilaginous elements, hair and a greasy, pappy mass." Rolleston's action, in placing this case under the heading "Embryomas and Teratomas," seems in accord with the views of the more modern pathologists. Adami and Nicholls (*The Principles of Pathology*, 1909, vol. ii, p. 862) believed that the term "dermoid" had lost much of its significance and might be misleading. "It is commonly held, for example," these authors stated, "that the dermoids are cysts composed of more or less modified skin with other structures of epidermal origin. Careful study has shown, however, that even the simplest of them contain structures from the other primitive germ layers." Consequently, the distinction between "dermoid and teratoma" is an artificial one, and had better be discontinued. It is simpler and more correct to class all the growths of this kind under one generic term "teratoma." W. G. MacCallum (*A Text-book of Pathology*, 2nd Ed., 1920, p. 1081), under the heading of "Dermoid Cysts," wrote: "They are, as the name implies, composed essentially of derivatives of the ectodermian layer, but there is no line between them and the more complex teratomata—indeed, all dermoids on closer examination prove to have a more complicated structure than is apparent at first sight." J. Ewing (*Neoplastic Diseases*, 2nd Ed., 1922, p. 966) writes: "It is especially difficult to distinguish between certain complex dermoids and teratoid growths with predominance of ectoderm." Rolleston (*Diseases of the Liver*, etc., p. 468) cites the literature on these conditions. W. T. Reynolds (*The Medical Herald*, St. Joseph, April, 1912, N. S., vol. xxi, p. 168) has reported a case which seems to belong to this group. In this cyst Reynolds found hair and part of the cyst-wall contained stratified squamous epithelium and a hair follicle.

2. Under "pseudocysts" may be grouped cystic degenerations of carcinoma and of sarcoma, softening of cirrhotic nodes and cysts due to hemorrhage. The case of Lisyanski and Lyudkevich (see below) apparently was one of pseudocyst after hemorrhage.

3. Lymphatic cysts of the liver may occur. Stengel and Fox (*A Text-book of Pathology*, 1921, p. 709) write: "Occasionally small cysts are seen which suggest origin from dilatation of the lymphatic channels." Lymphatic cysts, according to E. Ziegler (*Lehrbuch der Allgemeinen und Speciellen path. Anat.*, vol. ii, Jena, 1892), are very rare. Leppmann says that they contain clear, watery, yellowish fluid, with albumen and a large percentage of sodium chloride. They do not contain bile and are lined with endothelium. As a rule, they remain insignificant in size.

4. The association of cystic kidneys with cystic degeneration of the liver was first observed by J. S. Bristowe (*Transactions of the Pathological Society of London*, 1856, vii).

Of the eighty-five cases of non-parasitic cysts collected by Eli Moschcowitz (*The American Journal of the Medical Sciences*, April, 1906, N. S. cxxi) the liver alone was involved in ten only. Moschcowitz says that this disease occurs at all ages and in his collection was found twice in the foetus, seven

times in the newly born, four times in the first year, and, thereafter, at various ages up to eighty-one. According to Rolleston (*The Oxford Medicine*, vol. iii, 1921) this condition may be easily overlooked in infants unless the liver is subjected to microscopic examination. Cystic kidneys are common without any involvement of the liver, but cystic disease of the liver is nearly always accompanied by cystic kidneys. Sometimes, not often, there are also cysts in other organs, such as the spleen, pancreas or ovary. In infants the cysts may be entirely microscopic, or very minute, and the liver normal in size. In adults the cysts are of various sizes and enclosed in fibrous capsules and the liver may be greatly enlarged. Microscopically, the cyst-wall from the infant has dilated tubules lined with subcolumnar epithelium and surrounded by fibrosis. In the adult the microscopic picture is similar but, of course, the cells are more advanced in age. In the smallest cavities the epithelium is columnar; in those of medium size it is low and cubical; in the larger cysts the cellular lining may be absent or consist of an incomplete layer of flattened cells (Kilvington). The fluid from such cysts is usually clear, albuminous and free from bile; sometimes cholesterin, leucin, blood and creatinin are present (Rolleston). Moschcowitz writes: "Although non-parasitic cysts of the liver are most commonly met with as post-mortem surprises, they nevertheless possess definite clinical interest." He cites well-known cases where the cyst in the liver of a foetus was so large as to obstruct delivery and says that, if they grow very rapidly they may cause a severe, constant pain in the hepatic region. Clinically, there is neither jaundice nor ascites in these cases, and in the absence of enlargement of the liver or of a definite tumor there will be no symptoms ascribable to the liver. Of course, enlarged liver and kidneys, when present with uræmia will suggest the diagnosis. The treatment is that of chronic nephritis. Rolleston believes that operative drainage of such a liver ought to be avoided. H. Kehr (*W. T. Bull's Translation of "A System of Practical Surgery,"* by Bergmann, Bruns and Mikulicz, vol. iv, 1904) taught that, if such cystic disease were found on exploratory incision, the abdomen ought to be closed at once.

Theories on the origin of cystic disease of the liver have been numerous. Prominent among those who have either advanced or reviewed such theories are: P. H. Pye-Smith (*Transactions of the Pathological Society of London*, xxxii, 1881), Sabourin (*Archives de Physiologie normale et pathologique*, 1882, vol. ii, and *Progrès Médical*, May 17, 1884, No. 20), G. H. Savage and W. Hale White (*Transactions of the Pathological Society of London*, 1884), G. F. Still (*Transactions of the Pathological Society of London*, xlix, 1898), Leppmann, Rolleston, Kilvington, Blackburn, Eli Moschcowitz, Fieschi, von Hippel (*Virchow's Archiv*, cxxiii), Ribbert (*Verhandlungen der Deutsche Pathologischen Gesellschaft*, 1899), Siegmund (*Virchow's Archiv*, cxv), Borst (*Festschrift der Physikalisch-Medicinische Gesellschaft*, Würzburg, 1899), H. Coenen (*Berl. klin. Wochenschrift*, 1911), Sidney Boyd and J. Ewing. I shall merely outline those theories which have attracted the most attention. According to Moschcowitz, the earliest theory is the inflam-



matory theory of Förster, who regarded these cysts as dilated bile-ducts shut off from the general biliary circulation by inflammatory growth of new connective tissue. Pye-Smith thought that vacuolation of liver cells fused and thus formed cysts. Sabourin believed that these cysts developed in two ways: The first variety, from preëxisting bile-ducts; the second variety, from new canaliculi. The second variety were veritable biliary angiomas growing apace with a process of cirrhosis. Eli Moschcowitz discovered in the fibrous tissue of the portal spaces of cystic livers aberrant bile-ducts which do not exist in normal livers. George F. Still held that, while the bile-ducts proper are developing normally, certain hypoblastic cells, instead of performing their normal function of helping to form part of the duodenal diverticulum, engage in the manufacture of cystic tubes. The excess of fibrous tissue, often considered inflammatory, Still believes, is persistent mesoblastic stroma. Ewing (*Neoplastic Diseases*, 1922) says that any neoplastic element present is more probably adenomatous than fibrosarcomatous, as suggested by Rindfleisch. Ewing writes: "A congenital malformation is undoubtedly the original factor."

5. The possibility of cystic formation in the liver arising from blood-vessels, according to Kilvington, cannot be denied. The pathological report upon John B. Deaver's case of cyst of the liver was "hæmangioma."

6. Either the single adenoma or the multiple adenomata of the bile-ducts may become cystic (Rolleston). The cystic cavities are epithelial-lined and contain clear or turbid fluid which is albuminous and varies in color. Ewing questions the neoplastic nature of some of Leppmann's reported cases. Ewing writes: "A true multilocular cystadenoma was successfully removed by Keen. It weighed 113 gms. and contained many cavities lined by cylindrical cells and supported by fibromuscular tissue."

7. Ciliated epithelial cysts of the liver have been described by Girode (*Études sur les Maladies du foie*, 1888, p. 295, Hanot and Gilbert, cited by Tuffier), N. Friedreich (*Virchow's Archiv*, Band xi), Eberth (*Ibid.*, Band xxxv), F. von Recklinghausen (*Ibid.*, lxxxiv) and by F. W. Zahn (*Ibid.*, 1896, cxlxxx, p. 175). They are unilocular, not larger than a walnut and free from bile. Their usual location has been upon the anterior surface, near the suspensory ligament and along the inferior border (Ewing). Zahn says that they are just beneath the liver capsule. Von Recklinghausen thought that they were mucous retention cysts. Zahn believes them to be the result of an unknown embryonal formation. Ewing says that their origin is not readily explained. Leppmann, after describing them in a separate division, states that they must be included with the retention cysts.

8. "Retention cyst" is the histological diagnosis of the case recorded in this paper. A retention cyst of the liver is due to the engorgement of a bile-duct. Virchow (*Die Krankhaften Geschwülste*, Berlin, 1863) said that either calculi or cicatrices prevented the duct from emptying itself, but made no mention of the epithelium which, Leppmann thinks, is to be considered. In the case reported there has been no sign either of stone or of scar and

there has been no history either of trauma or of inflammation. It is possible that an unrecognized irritation has caused swelling and hypersecretion in a bile-duct, with occlusion of its outlet. In the cases studied by Adami (*The Principles of Pathology*, 1908, vol. i, p. 788) there had always been a marked degree of fibrosis around the bile-ducts in the immediate neighborhood of the cysts. The ease with which the liver was sutured suggests that there was some degree of fibrosis present. These cysts have contained serous or mucous fluid, or, as in the case reported, bile.

The diagnostic methods employed to differentiate a hydatid cyst of the liver from a cyst, tumor or accumulation elsewhere in the abdomen, are equally applicable to the non-parasitic cysts of the liver and are set forth in detail in several text-books.

Whether a cyst of the liver be hydatid or non-parasitic it is impossible to determine until the fluid, at least, from such a cyst and, perhaps, also its wall have been examined. Puncture of a suspected hydatid through the abdominal wall is no longer permitted by the teachings of modern surgeons. Such a procedure may be followed, immediately, by urticaria, convulsions, collapse or even death; and more remotely, by peritonitis, or secondary implantation of daughter cysts. The fluid from a living hydatid cyst is said not to be toxic but, before tapping a cyst, it is impossible to tell if it be alive or dead. Symptoms from the living hydatid fluid have been ascribed to anaphylaxis (Rolleston, *The Oxford Medicine*, vol. iii, 1921). Rapidly increasing familiarity with the technic of local anæsthesia would seem about to abolish any excuse for tapping abdominal cystic tumors without preliminary laparotomy.

Examination of the fluid alone will reveal the parasitic character of most hydatid cysts. In the sterile hydatid, however, no reproduction having occurred and the fluid being free from scolices, hooklets or daughter cysts, identification necessitates microscopic study of the cyst wall. Many years ago Sir Benjamin C. Brodie (*Lectures*, London, 1846, p. 105) discussed two very interesting cases. It seems that in 1822, with a flat trocar, he punctured a tumor in the right hypochondriac region of "a young lady about twenty-three years of age." Three pints of watery fluid were evacuated. Six years later there had been no return of the tumor. A few months after he had treated the lady, he tapped the same region of a boy about twelve and drew off a pint and a half of the same kind of watery fluid. He believed that he had been dealing with two cases of non-parasitic cyst. Mr. Hawkins (*Medico-Chirurgical Transactions of London*, vol. xviii, p. 118), in reporting these two cases, stated that the fluid from each case was not coagulated by heat. George Budd ("*On Diseases of the Liver*," 3rd American Edition, Phila., 1857, p. 464) thought that both these cases were probably instances of sterile hydatid cyst. The fluid from a living hydatid cyst contains no albumen, is colorless and among other ingredients has succinic acid and sugar. Scolices and hooklets are not free in the living cyst, but become detached on the death of the parasite or are dislodged by paracentesis. After the parasite dies the

fluid in the cyst becomes turbid, albuminous and toxic (mytilotoxin). The fluid from a non-parasitic cyst contains albumen, varies in color, may have other components in addition to albumen, but does not contain sugar, succinic acid or, of course, any of the hydatid elements.

On section the typical hydatid cyst is found to be composed of an outer capsule, or ectocyst or adventitia and an inner membrane or endocyst which, with its burden of daughter cysts, may be readily shelled out by the hand of the operator. The ectocyst has a characteristic laminated appearance. The non-parasitic cyst is usually, not invariably, lined with epithelium or endothelium.

Because of its low tension compared with that of a hydatid cyst, F. Bird (Kilvington) suspected a fluid tumor of the liver to be a non-parasitic cyst. This suspicion was confirmed by a successful operation.

Rolleston (Diseases of the Liver, etc.) warns us that during an operation the anatomical relations of the cyst must be noted in order to differentiate it from idiopathic dilatation of the extrahepatic bile-ducts. According to Erik Waller (ANNALS OF SURGERY, 1917, vol. lxvi, p. 446), when it becomes evident that the sac of the cyst consists of a greatly dilated common duct, the only rational treatment is primary choledocho-enterostomy. Waller reported one case and collected thirty-four. Thirty of these cases were operated upon: in twenty-one the cysts were sutured to the abdominal wound and fistulæ established; they all died after longer or shorter intervals. In three cases the sacs were extirpated; these three died. Upon the five cases that recovered anastomosis between the common duct and the small bowel had been performed. A. A. McConnell (British Journal of Surgery, 1920, vii, p. 520) reported one case of cyst of the common bile-duct, recommended anastomosis between the cyst wall and duodenum or jejunum and stated that both drainage and extirpation were improper procedures. He said that this condition should be called "diverticulum" of the common bile-duct.

Santoni in 1894 detected, by auscultatory percussion, a peculiar, low booming which lasted but a brief time and stopped abruptly, and has been considered pathognomonic of hydatid disease (Deaver and Ashhurst, Surgery of the Upper Abdomen, 2nd Ed., 1921). Of course, both Santoni's sign and hydatid thrill will be absent from non-parasitic cysts.

For several years the reliability of hydatid thrill as a diagnostic sign of echinococcus cyst has been questioned by certain writers. Over twenty-five years ago Huber (Twentieth Century Practice, vol. viii, 1896, p. 520) wrote that he failed to observe the thrill in over one-half of his cases and quoted Bamberger as declaring "the manifestation worthless and as only a fluctuation sign which is even more frequent in ascites and ovarian cysts." Semmla and Gioffredi (Twentieth Century Practice, vol. ix, 1897, p. 452) thought that hydatid thrill was gradually losing its reputation as a valuable sign—citing Concato as having observed it in sterile cysts, and Caradelli (or Cardarelli?) as having noted it in hydronephrosis. Rolleston (Diseases of the Liver, etc.) wrote that the thrill could be obtained in sterile hydatid cysts,

in tense cysts of other kinds, such as hydronephrosis and sometimes in encysted ascites. Chauffard believed that hydatid thrill could occur "in general ascites under certain conditions, such as an elastic state of the abdominal walls in young persons" (Rolleston). Kehr said that it might be present in cystosarcoma of the liver (H. H. Haubold, *The Principles and Practice of Surgery*, 1921). Lancereaux (Rolleston) observed hydatid thrill twice only in sixty cases; Finsen (Haubold), not at all in 268 cases. G. M. Reykjavik, of Iceland (*Archiv für klin. Chirurgie*, B 100, Heft 2, cited by Barnett), wrote: "Hydatid fremitus is noted in a record of three out of 169 cases operated on, and the symptom is regarded owing to its rarity as of very little diagnostic significance."

On the other hand, F. Dévé (*Les Kystes Hydatiques du Foie*, 1905, cited by Barnett) had encountered hydatid fremitus six times in thirty-six cases and did not think that the tremor in other liquid swellings was quite the same as the true hydatid thrill. Dévé concluded that in practice we might consider the fremitus as pathognomonic of the existence of a hydatid cyst—at least, when it was produced quite clearly in the region of a protuberance from the liver. The most recent author on "hydatid thrill" seems to be L. E. Barnett, of New Zealand (*New Zealand Medical Journal*, October, 1921, vol. xx, p. 277), who has elicited hydatid thrill seven times in over three hundred cases. In each one of the cases in which the hydatid thrill had been demonstrated, the following conditions were found: the mother cyst was close to the abdominal wall; the cyst's walls showed signs of degeneration "leading to a slackening of the high normal tension that exists within the usual hydatid cyst." A few large daughter cysts were present, not closely packed together, but having room to vibrate in contact with the walls of the mother cyst. Barnett's illustrations are drawn to show that; in a single tense cyst there is no thrill; in a single slack cyst there is a "wavy fluctuation" but no thrill; in a cyst containing daughter cysts, tightly packed together, there is no thrill; in a cyst with a few large daughter cysts, not tightly packed together but able to vibrate in contact with the walls of the parent cyst, there is hydatid thrill. Barnett states: "The distinctive feature of the true hydatid thrill is the exquisite spring-like vibration which is quite distinctly prolonged beyond the moment of percussion, and which is associated with the remarkable drum-like resonance heard on auscultatory percussion." Barnett adds that hydatid fremitus of this character is the only form pathognomonic of hydatid cysts. According to Huber, hydatid thrill (*Fremissement hydatique*) was pointed out in 1801 by Blatin and first clearly described in 1828 by Briancon.

The various laboratory tests for hydatid disease ought to be negative in cases of non-parasitic cyst of the liver. The miostagmin, Abderhalden and intradermic reactions, the complement-fixation and precipitin reaction tests, as well as a cutaneous test for hydatid disease have been described recently by T. B. Magath (*The Medical Clinics of North America*, September, 1921, vol. v, No. 2, p. 563). While the complement-fixation test was nega-

tive in one of Rosenstein's cases and in Munk's case, it was positive in Tuffier's case. Kilvington (Medical Journal of Australia, December 17, 1921) found the complement-fixation test "absolutely accurate" in his cases of hydatid disease.

Diagnosis of non-parasitic cysts of the liver has seldom been made before operation or before necropsy. From the reported cases it would seem that non-parasitic cysts seldom become large enough to cause manifestations during life. On the few occasions on which they have caused local signs, the latter have been the signs of a growing abdominal tumor either obviously hepatic and usually considered echinococcic, or not apparently connected with the liver and adjudged ovarian, hydronephrotic or some other cystic condition. The X-rays may show, as in Dujarrier's case, that the tumor is part of the liver shadow.

Jaugeas (Archives of the Röntgen-ray, vol. xviii, June, 1913, to May, 1914, p. 48) tells us that in one of Bécère's cases the radioscopic examination revealed a nodosity in the upper anterior part of the liver. A diagnosis of hydatid cyst was made. The supposed cyst was punctured without result and a subsequent laparotomy disclosed a solid, syphilitic tumor. Where it is uncertain whether the tumor be connected with the liver or not, radioscopic examination may show the relations of the cyst to the liver shadow, or, on the contrary, by showing a normal hepatic shadow, demonstrate that the tumor has nothing to do with the liver (Jaugeas). "In other cases, where the clinical examination had led to a suspicion of hepatic disease, the screen examination may demonstrate the existence of a purulent pleurisy instead of a liver abscess or a pulmonary tumor in lieu of a hydatid cyst" (Jaugeas). Bécère, Cottenot and Laborde (Radiologie et Radium therapie, being vol. xxxii of *Traité de Pathologie Médicale et de Thérapeutique appliquée*, edited by Sergent, Ribadeau-Dumas and Babonneix, Paris, 1921, p. 213) teach, among other things, that the hydatid cyst can develop entirely in the parenchyma and show no irregularity of the hepatic borders. Usually, it shows no difference in opacity from the neighboring liver tissue and is missed at examination. Exceptionally, these authors state, one can distinguish "a regularly rounded zone which is a trifle more opaque." R. Kienböck (Fortschr. a. d. Geb. d. Roentgenstrahl, Hamburg, 1913, xxi, p. 77, cited by Barker in *Monographic Medicine*, 1916, vol. iii, p. 650) reported a case of hydatid cyst of the liver in which the diagnosis was made by X-ray examination. Recently, Fritz Partsch (Deutsch. med. Wochenschrift, August, 1921, abst. International Medical and Surgical Survey) has reported that, by means of Rautenberg's pneumoperitoneal method, he had made the correct diagnosis in seven cases of echinococcus of the liver.

In the sixty-one cases of non-parasitic cysts, a list of which is appended to this report, "hydatid cyst" and "ovarian cyst" have been the diagnoses most frequently made. Leppmann's diagnosis was "cystic tumor of the liver, probably hydatid," and he also considered right-sided hydronephrosis and mesenteric cyst; von Haberer thought that he was dealing with a pan-

creatic cyst or with tuberculous peritonitis; Bland Sutton's case clinically resembled mesenteric cyst; Corner's case suggested distention of the gall-bladder; Soto believed that he had a case of suppurative cholecystitis; before operation, Orloff considered primary carcinoma, hydatid cyst and cystic degeneration; Fritz Munk's diagnosis was "a sessile tumor of the liver, having nothing to do with the gall-bladder"; Fieschi, before operation, made a diagnosis of "simple cyst of the liver with chronic angiocholitis"; Gri-garyeff, because he had observed another similar case, made a diagnosis of "probable cystadenoma."

Seldom have accidents been recorded in connection with non-parasitic cysts of the liver. Kilvington (*Intercolonial Medical Journal of Australasia*, 1902, vol. vii) cites Allen's case of a young woman who suddenly collapsed and died after symptoms "like those of rupture of a large internal aneurism." Necropsy showed that the liver was the site of a non-parasitic cyst which was filled with blood from one of the large dilated blood-vessels in the cyst-wall.

Infection of these non-parasitic cysts of the liver has not often been recorded. C. Murchison (*Clinical Lectures on Diseases of the Liver*, etc., 3rd ed., edited by T. Lauder Brunton, 1885, cited by Fieschi) reported a case of non-parasitic cyst of the liver which had suppurated and opened into the peritoneal cavity, causing death. Bouilly (*Bulletins de la Societé Anatomique de Paris*, 1874, vol. xvii, reported 1872, cited by Tuffier) held a post-mortem on a case of suppuration in a non-parasitic cyst of the liver. The cause was not known.

About twenty-five years ago H. J. Waring (*Diseases of the Liver, Gall-bladder, etc.*, 1897, p. 137), speaking of hydatid and non-parasitic cysts of the liver, said: "The treatment of both varieties of cyst is, however, similar and a mistake in the diagnosis is not of much importance."

Usually, in the case of a hydatid cyst, after removal of the endocyst, it has not been deemed prudent to attempt to detach the adventitious sac or ectocyst from the liver because of the danger of fatal hemorrhage; but the operator has stitched the open ectocyst to the abdominal incision, making a pouch of (or marsupializing) the sac. The interior of the cyst has been disinfected by a chemical either before (Quenu) or after cutting into the ectocyst. Often a drainage tube has been inserted into the marsupialized ectocyst. Less frequently, after evacuation of the endocyst and disinfection and drying of the interior of the ectocyst, the incision in the latter has been sutured and the abdomen closed without drainage. Closure without drainage seems to have grown in popularity in Australia (Kilvington, *Med. Journ. of Australia*, December 17, 1921; W. J. S. McKay, *Med. Jour. of Australia*, January 3, 1920). Occasionally, not often, the adventitious capsule has been firm enough to permit of complete excision of the hydatid cyst. Recently, C. E. Corlette (*Med. Jour. of Australia*, December 17, 1921) extirpated from the liver two partially calcified hydatid cysts. In the appended collection of non-parasitic cysts of the liver, because of difficulty of approach,

because of hemorrhage, because of the thinness of the capsule, because of the general condition of the patient or because of some other sound surgical reason, there have been more instances of marsupialization than of extirpation. Where hardening of the liver at the base of the cyst has been such as to permit of the passage of sutures (as in the case now reported), where there has been a firm, strong capsule, where it has been apparent from the beginning of the dissection that the cyst would separate with a reasonable amount of hemorrhage and where the cyst has had a definite pedicle, complete removal has been possible. McKay's method of handling the adventitious sac of a hydatid cyst could be used in the treatment of certain types of non-parasitic cysts. After he has removed the endocyst, disinfected and dried the interior of the ectocyst, he sutures the ectocyst to the abdominal incision, the catgut passing through the peritoneum, muscles and aponeurosis but not through skin. Then he closes the abdominal wall over the opening of the attached sac. If anything goes awry, a drainage tube may be inserted into the cyst by removing a few of the skin sutures. I think that most surgeons believe that the outer capsule of a hydatid cyst should be sutured to the abdominal wall—whether the latter be closed afterwards or not. McKay makes a commendable attempt to prevent the sinus which may last for months or even years after marsupialization of either a hydatid or a non-parasitic cyst. Of course, it would be necessary, in the case of the non-parasitic cyst, to destroy the secreting lining—preferably by means of a chemical, as a curette might start hemorrhage. In dealing with a non-parasitic cyst of the liver, if neither extirpation nor marsupialization be deemed desirable in a given case, the cyst-wall may be anastomosed to the duodenum (see Burghard's case).

In the appended sixty-one cases trauma has appeared in the history in four cases. In the celebrated case of Alban Doran the history of a blow on the right hypochondrium nearly three years before jaundice began, suggested to Doran that the blow might have ruptured a bile-duct and caused very slow extravasation of bile into bruised liver substance, thus forming a cystic cavity. In Guerkin's case the patient, about four years before his first operation, injured the region of his liver, by falling on a fence. In the case reported by Lisyanski and Lyudkevich the patient noticed heaviness in the right half of her abdomen several years before her operation, and two months before her operation suffered a slight sprain of the right side of her back "in the region of the waist-line." Soto's patient had a tumor in the liver region for several years and then she struck it while bathing. While it is theoretically possible for an injury to rupture a bile-duct or to cause hemorrhage into the liver, which may be followed by a pseudo-cyst, I do not believe such traumatic genesis can be proved.

In the appended list of reported cases I have not included the cyst removed by W. J. Mayo, and reported by M. S. Henderson (*ANNALS OF SURGERY*, 1909, vol. 1, p. 550), because at operation it was noted "that the

cyst had its origin in the lower two inches of the round ligament of the liver, etc.”

Through the kindness of Dr. W. J. Mayo and Dr. Stuart W. Harrington, I am permitted to quote statistics on non-parasitic cysts encountered in the Mayo Clinic. The following is from Doctor Harrington's letter of July 18, 1922:

“I find that in all we have 25 cases of single cysts of the liver, and 10 cases of multiple cysts of the liver. Of the single cysts the great majority were found during operations for other conditions—mostly for diseases of the gall-bladder. In the 25 cases, 14 were found during an operative procedure on the gall-bladder itself where a diagnosis of cholecystitis had been made and the pathology found in the gall-bladder; 5 were found during operations for ulcer, 3 at operations for carcinoma of the stomach, and 3 were found when we operated for tumor or cyst of the liver. The last three cases were all very large cysts which were palpated in the abdomen in the right lobe of the liver, beginning just outside the gall-bladder. One contained about 5 litres of milky fluid; the other two contained clear fluid.

“In the great majority of these cases, the cyst was located about the gall-bladder fossa, usually to the right of the gall-bladder, extending behind the cystic duct, at times causing pressure on the cystic duct. They varied in size from one inch in diameter to six or eight inches in diameter. One patient was twenty-five years of age, one was twenty-four years, seven were in the fifties, eight in the sixties, five in the forties, two in the thirties, and one in the seventies. There were eight males and seventeen females. All of these cysts were examined by the pathologists and found to be simple. There was no mortality at operation.

“There were only ten cases of multiple cysts of the liver, eight of which were in females and two in males. One patient was thirty years of age, four were in the fourth decade, two in the fifth, and three in the sixth. In this group the cysts ranged in size from the size of a pea to that of an orange, and there was considerable cystic disease of the entire liver. Two cases were associated with chronic cystic disease of the kidneys. Most of the cysts contained clear fluid, but in some the fluid was bile stained. There was no definite symptomatology for this group. Five cases were operated upon for abdominal tumor—probably cyst of the liver, two for cholecystitis with stones, one for duodenal ulcer, and two ovarian and uterine fibroids.”

#### A LIST OF REPORTED NON-PARASITIC LIVER CYSTS OPERATED UPON SURGICALLY

This list is confined to brief reports of cases which have undergone surgical operations, containing résumés of cases of non-parasitic cysts, asserted or proved, and of non-parasitic cystic formations or degenerations. The compiler of this list has used Sidney Boyd's collection of thirty-four cases which includes eighteen cases collected by C. Hofmann and three cases collected by A. Doran. P. S. Ikonnikoff's collection of twenty-one cases is



also contained in Boyd's list. The writer has added twenty-six cases to Boyd's thirty-four and has supplied one case, making a total of sixty-one. The article by Lisysanski and Lyudkevich and the one by Ikonnikoff have been abstracted in English by Dr. R. Vera Zabarkes. The report of a chemical analysis by Steensma, the case reports by Grigoryeff and by Guerken, as well as the two case reports by Rosenstein, have been translated into English by The American Institute of Medicine. In each of the following cases the diagnosis may be considered positive or probable according to whether or not the cyst-wall has been examined microscopically. Where the operator is not the reporter of the case, the operator's name appears first and the name of him who reports or cites the case appears second, in parenthesis. Usually, but not invariably, information concerning each case is limited to the following notes: Operator; by whom, when and where reported; sex and age of patient; anatomical location of cyst; contents of cyst; method of operation; report of pathologist; result of operation.

1. GLOZ, 1864 (Inaugural-Dissertation, Tübingen, 1864, cited by Karl Winckler, Inaugural-Dissertation, Marburg, 1891). Male, twenty-eight. Lower and anterior surface of right lobe. Six litres from two tapplings. Greenish-yellow, clear fluid containing albumen. Multiple punctures. Death from suppuration after third puncture. This was before the inauguration of antiseptis. (It is quite possible that Bruns operated on this case; I have not been able to consult the original report).

2. W. COUSINS, 1874 (British Medical Journal, 1874, vol. ii, p. 700). Female, twenty-seven. Lower surface. Two and one-half gallons of clear, limpid, yellow fluid. Resected and stump fixed to wall of abdomen. Died in thirty-six hours from peritonitis. C. Langenbuch (Chirurgie der Leber und Gallenblase, 1897, Part ii, p. 23) speaks of this case as follows: "The inner surface of the cyst was rough and considered in course of degeneration, but to what variety this cyst belonged and if it might not have been a question, perhaps, of an acephalic echinococcus—is not quite clear from the publication." Doran (Trans. Royal Med. and Chirurg. Soc., 1904), however, says that when Goodhart mounted this cyst as a specimen in the museum of the College of Surgeons (Path. Series 2758), he could find no hydatid elements in it.

3. ALFRED NORTH, 1882 (Medical Record), New York, September 16, 1882, vol. xxii, p. 344). Male, forty-five. Left lobe. Five pints of coffee-colored fluid containing bile and albumen. Cyst size of man's head. Puncture. Died two days later; peritonitis. Stones in gall-bladder and in common duct. No signs of hydatid in the cyst. Post-mortem. Right kidney cystic.

4. KALTENBACH, 1885 (Karl Winckler, Inaugural-Dissertation, Marburg, 1891). Female, age not given. Lower surface. Large multilocular tumor from which 320 litres of viscid, greenish-brown fluid were obtained by several punctures. Microscopic examination of contents gave negative results. Entire cyst extirpated. After tightening an elastic ligature around the base "a hand's breadth of liver lobe" was removed. Hemorrhage controlled by sutures. Recovered. Kaltenbach writes to Winckler, about 1890: "The woman is now, after five years, still well except for diabetes." Leppmann (l.c.) remarks that this was an extremely large multilocular cyst, adherent to the liver, but its origin could not be fully established.

5. KÖNIC, 1886 (Hüter, Inaugural-Dissertation, Göttingen, 1887). Female, eleven. Right lobe. Cyst contained brownish-gray fluid. Extirpated. Numerous large and small cysts lined with cylindrical epithelium. Cyst-adenoma of bile-ducts. Recovered.

6. LOUIS McLANE TIFFANY, 1890 (Reported June 6, 1890, at the 236th meeting of the Clinical Society of Maryland, Maryland Med. Jour., Baltimore, October 18, 1890, vol. xxiii, No. 25, p. 531. Also International Medical Magazine, 1892, vol. i, No. 3, p. 235). Male, twenty-five. Convex surface of the liver. Nodule size of a walnut "Composed of liver tissue in which there was much exudation, while scattered through the growth were many fine grains of sand—no doubt, minute calculi." Tumor excised by means of curved scissors and wound in liver cauterized. Recovered. Diagnosis not made. According to W. W. Keen, this is the first recorded case of liver resection in America.

7. AHLFELD, 1890 (Karl Winckler, Inaugural-Dissertation, Marburg, 1891). Female, thirty-eight. Lower surface. Eight litres of slimy, yellow fluid, containing albumen. Incision and drainage. A piece of the cyst-wall was excised for study. On the inner surface of the cyst-wall neither epithelium nor glands could be detected. Recovered. Still had a fistula several weeks after operation.

8. W. MÜLLER, 1891 (Verhandlungen der deutschen Gesellschaft für Chirurgie, 1893). Female, fifty-nine. Lower surface. Six litres of chocolate-colored fluid. Two-thirds of cyst-wall excised and remainder sutured to abdominal wound. Large and small cysts lined with epithelium. Cystadenoma. Recovered. Re-examination six years after operation (Verhandlungen der deutschen Gesellschaft für Chirurgie, 1897, vol. i, p. 137) and patient in good condition.

9. TERILLON, 1891 (Bulletin et Mémoires de la Société de Chirurgie, 1891). Male, fifty-two. Intrahepatic. Two litres of biliary fluid. Puncture. Died three months later. Carcinoma of liver and gall-bladder. Dilatation of bile-ducts. Probably a retention cyst.

10. W. W. KEEN, 1892 (Boston Med. and Surg. Journal, 1892, vol. cxxvi, p. 405). Female, thirty-four. Thermo-cautery and enucleation. Four very large vessels tied with catgut. Edges of liver wound united by fine silk. Stump returned to abdomen. Abdominal wound closed after inserting a glass drainage tube which was removed after 48 hours. Stitches removed at the end of a week. Diagnosis: Cystic adenoma of the bile-ducts weighing 113 grams (3½ ounces). Size: 9 by 11½ cms. and 4½ cms. thick at base. Well eight years later. (ANNALS OF SURGERY, 1899, vol. xxx, p. 267).

11. BAYER, 1892 (Prager Medicinische Wochenschrift, 1892, No. 52). Female, fifty-six. Filled entire liver. Eight litres of brownish-gray fluid. Incision and drainage. Dilated bile-ducts; atrophy of liver tissue; thick interstitial tissue; cyst-wall two to four mm. thick. Slowly recovered.

12. A. W. MAYO ROBSON, 1892 (On Gall-stones and Their Treatment, 1892, Case 28). Female, forty-two. Right lobe. Six ounces of clear, straw-colored fluid. Opened by cautery. Cholecystostomy for gall-stones. Operative recovery. Died several weeks after operation from broncho-pneumonia.

13. KÖRTE, 1893 (C. Langenbuch, Chirurgie der Leber und Gallenblase, Deutsche Chirurgie, Lief. 45 C., Bd. i und ii, Stuttgart, 1894 und 1897). Sex not given. Age, forty-five. Margin of liver. Serous fluid. Cysts the size of eggs. Incision and drainage. Recovered.

14. BERG, 1894 (Hygieia, Band IV, 1894). Female, forty-five. Anterior border of left lobe. Resection. Recovered.

15. JOHN B. ROBERTS, 1894 (ANNALS OF SURGERY, February, 1894, vol. xix, p. 251; The American Journal of the Medical Sciences, December, 1894, and elsewhere). Female, fifty-six. Great enlargement of the liver. Cysts intrahepatic. Operation in two stages; first, stitched the prominent of several cysts to parietal peritoneum; second, seven days later, laid open adherent cyst and through it the other cysts. Fluid clear and limpid, contained albumen and was negative for hydatid elements. Died three weeks after operation of pleuro-pneumonia,

etc. Diagnosis, cystic adenoma. Both kidneys cystic. Liver weighed eleven and one-half pounds.

16. W. MÜLLER, 1897 (*Verhandlungen der deutschen Gesellschaft für Chirurgie*, 1897, vol. i, p. 137). Female. Right lobe. Clear serous fluid. Resection of large wedge of liver left a space communicating with numerous small cysts. Cystic adenoma. Died eleven days after operation from pulmonary embolism. Similar cystic degeneration of kidneys.

17. SCHMIDT, 1897 (H. J. Waring, "Diseases of the Liver," etc., 1897, p. 154). Female, sixty. Location and contents of cyst not stated. He removed from the liver a small tumor which contained a number of cysts. Thought to be cystic adenoma. Recovered. No recurrence. Well six years after operation.

18. CHOBAC, 1898 (*Wiener klinische Wochenschrift*, 1898, No. 14). Female, forty-six. Right lobe. Half a litre of yellowish-green fluid containing albumen. No sugar. No signs of hydatid elements. No succinic acid. Multiple cysts. Two-stage operation. Incision and drainage. Recovered. Well five months after operation.

19. CZERNY, 1898 (Petersen, *Verhandlungen der deutschen Gesellschaft für Chirurgie*, 1898). Sex and age not given. Part of liver involved not stated. Cyst of the bile-ducts. Resected. Recovered.

20. A. A. BOBROFF, 1898 (*Khirurgia*, 1898, vol. iv, p. 36, and *Centralblatt für Chirurgie*, 1899, No. 10). Female, fifty-one. Lower surface. Part of cyst-wall excised and the remainder sutured to the abdominal wall. Cavity of the cyst lined with epithelium. Adenocystoma. Recovered.

21. PORTER, 1900 (Shattuck, *Boston Medical and Surgical Journal*, 1900, p. 427). Female, sixty-three. Top of liver near falciform ligament. One gallon of clear, colorless fluid. Incision and drainage. Small cysts and bile-ducts in wall of cyst. Cystic-adenoma. Died several months later following an operation performed to cure the chronic sinus.

22. ROBERT SCHULTZE, 1900 (F. Leppmann, *Deutsche Zeitschrift für Chirurgie*, 1900, vol. liv, p. 446). Female, fourteen. Lower surface. Two-stage operation: August 3, 1898, cyst drawn out and sutured to abdominal wall; August 7, 1898, sac resected and drained. Cyst, size of child's head, contained about 1500 c.c. of a brownish fluid. Much mucus and albumen present. Succinic acid and sugar absent. No evidence of microscopic constituents of hydatid. Cyst wall consisted of three layers of connective tissue lined by tall columnar epithelium. Recovered, but fistula remained.

23. C. HOFMANN, 1902 (*Mittheilungen aus den Grenzgebieten der Medizin und Chirurgie*, 1902). Female, twenty-eight. Quadrate lobe. Yellowish-gray fluid containing albumen. Excision of entire cyst. Cyst-wall had three layers of connective tissue paved with cuboidal epithelium. Cystadenoma. Recovered.

24. F. BIRD, 1902 (Basil Kilvington, *Intercolonial Medical Journal of Australasia*, Melbourne, December 20, 1902, vol. vii, No. 12, p. 557). Sex and age not given. Location in liver not stated. Contents of cyst not described. The cyst was opened, its walls sutured to the abdominal incision and the cavity drained. Patient recovered. Two years after operation, a similar but smaller tumor was detected in the liver. "This is probably an adjacent cyst enlarging, or possibly the old one refilling." Pathological report: Simple cyst.

25. A. DORAN, 1903 (*Transactions of the Royal Medical and Chirurgical Society*, 1904, and *British Medical Journal*, 1903, vol. ii), Female, forty-two. History of trauma to hepatic region. Right lobe. Forty-eight ounces of pure, deep green bile withdrawn from cyst. Operation: Incision and drainage. Recovered. Sinus which closed in nine months. Patient in good condition six months afterwards. (*British Medical Journal*, 1905, vol. ii.)

26. W. N. ORLOFF, 1903 (L. A. Diwawin, Russ. Med. Rundschau, Berlin, 1904, vol. ix, p. 534. Also *Khirurgia*, Mosk., 1903, vol. xiii, p. 433). Female, forty-five. Right and left lobes were overrun by several large cysts, varying in size from a grain of juniper to a hen's egg. Puncture of the cysts showed them to contain serous fluid. A part of the cyst-wall was removed for examination and pronounced cystadenoma. An umbilical hernia was cured at the same operation. Recovered from operation and after nine months was able to attend to her work.

27. G. B. MILLER, 1903 (American Journal of Obstetrics, vol. xlviii, August, 1903, p. 182). Female, two and one-half years. Miller reported the case as a congenital dilatation of the gall-bladder and bile-ducts but Doran believed it to be an intrahepatic cyst. The tumor occupied part of the liver, the round ligament and the suspensory ligament being attached to its upper surface. "The liver was largely replaced by the tumor." This liver substance represented the right lobe. It contained five pints of bile. Two-stage operation; opened by means of cautery. Recovered.

28. MORTON, 1903 (The Lancet, November 14, 1903, p. 1395). Female, sixty-three. Right lobe. Straw-colored fluid containing albumen; no sugar. Incision and drainage. Recovered.

29. A. A. BOBROFF, 1904 (L. A. Diwawin, Russ. Med. Rundschau, Berlin, 1904, vol. ix, p. 534). Male, thirty-nine. Left lobe of liver swollen to size of a child's head. Laparotomy and puncture of cyst. Three hundred cubic centimetres of a clear, light-yellowish fluid, containing 5 per cent. albumen, no sugar, no succinic acid and no hydatid elements. Abdomen closed with exception of gauze left in upper corner of wound to promote adhesions between liver and abdominal wall. Recovered from operation and was discharged from hospital one month after operation. Condition good for three months. Died five months after operation. For several days preceding death there were chills.

30. C. B. BLACKBURN, 1904 (Transactions of the Pathological Society of London, vol. lv, p. 203). Female, forty-nine. Upper surface of liver studded with small cysts, from the size of a grape to a split pea; on right lobe there was one larger one—about the size of a tennis ball. This was aspirated and contained no sign of hydatid membrane. The cyst fluid was straw-colored, had a trace of albumen and no sugar. No hooklets or other microscopic evidence of hydatid could be detected. Left kidney was cystic also. Recovered. In good condition three years afterwards.

31. J. A. REID, 1904 (C. B. BLACKBURN, Transactions of the Pathological Society of London, vol. lv, p. 216). Also *Intercolonial Medical Journal*, vol. i, p. 90). Male, sixty-two. Liver riddled with cysts of various sizes up to the largest one (size of a foetal head) which was opened and drained, bile-stained fluid for several days. Kidneys also cystic. Microscopically, after death in the larger liver cysts no definite epithelial lining could be made out, but in the smaller ones it was usually evident, the cells varying from flat to cubical or even columnar in type. In the cyst fluid was no evidence of hydatid; no scolices; no hooklets. Died on seventh day of uræmia.

32. BLAND-SUTTON, 1905 (British Medical Journal, 1905, vol. ii. Also *Centralblatt für Chirurgie*, 1906, vol. ix). Female, seventy-five. Left lobe. Two pints of brown fluid; no sugar. Cyst completely shelled out. Cyst-wall consisted of fibrous tissue lined with flat epithelium. Recovered.

33. S. P. THEODOROFF, 1906 (P. S. Ikonnikoff, Russkiy Vrach., Saint Petersburg, 1906, vol. v, p. 1181. Cited by von Haberer, 1909, Sidney Boyd, 1913, and translated into English for this article by Dr. R. Vera Zabarkes). Female, forty-four. Right lobe. Cyst as large as a child's head. Part of cyst-wall excised and

remainder fixed to abdominal wall. Pathological report. Cystic adenoma of bile-ducts. Recovered. Had fistula twenty-seven months after operation.

34. D. FIESCHI, 1909 (*La Clinica Chirurgica*, Milan, August 31, 1909, vol. xvii, p. 1457). Female, fifty-two. Liver extended to right iliac fossa and was covered with many transparent cysts varying in size from a grain of corn to a three-leaved clover. The cysts contained mucus slightly stained by bile. Gall-bladder enlarged and stone in cystic duct. In order to perform cholecystostomy an overhanging Riedel's lobe was excised. Microscopically, these cysts were lined with one, two or even three layers of epithelium. No evidences of hydatid elements. Post-operative diagnosis: Calculus of the cystic duct with partial obstruction; acute suppurative cholecystitis in a cirrhotic liver, hypertrophied and polycystic from mucous bile cysts; diffuse low-grade angiocholitis. Recovered, but fistula continued after two years.

35. HANS VON HABERER, 1909 (*Wiener klinische Wochenschrift*, 1909, vol. xxii, p. 1788). Female, thirty-four. The whole left lobe was the site of a cyst the size of a child's head. Clear, light-yellow fluid containing albumen. Hepatic artery ligated and entire left lobe of liver removed. The large cyst as well as several small ones lined by epithelium. Cystic adenoma of the bil-ducts. Abdomen closed without drainage. Healing by first intention and patient left hospital fourteen days after operation.

36. SHAW and ELTING, 1909 (*Archives of Pediatrics*, New York, 1909, vol. xxvi, p. 818). Female, one year and one-half. Right lobe. Nine hundred c.c. clear, yellow fluid; albumen. Incision and drainage. No epithelium could be detected in cyst-wall. Died from shock. Kidneys normal.

37. H. KÜTTNER, 1911 (*H. Coenen, Berl. klin. Wochenschrift*, 1911, p. 153). Male, fifty. Liver completely overrun with cysts of various sizes—the largest being the size of a goose egg. They contained a serous, opal fluid. Kidneys seemed normal. A few of the smaller cysts were excised for examination. They were lined with epithelium. Abdomen closed. Recovered and left hospital sixteen days after operation.

38. G. F. ALDOUS, 1911 (*British Medical Journal*, 1911, vol. ii, p. 688, September 23, 1911). Female, forty-three. "The swelling proved to be a solitary hepatic cyst occurring at the free border of the liver." Gall-bladder normal. Twelve pints of thin, dark, muddy fluid. Cyst-wall stitched to parietal peritoneum and drained. Recovered.

39. CORNER, 1912 (*The Medical Press and Circular*, February 7, 1912, N. S., vol. xciii, p. 142). Female, "in the latter half of middle age." Right lobe. Cyst was about four inches in diameter and contained a slightly opalescent fluid. Cut through liver and removed cyst entire and unopened. Gall-bladder normal. Pathological examination showed no indication of hydatid. Recovered.

40. W. T. REYNOLDS, 1912 (*The Medical Herald*, St. Joseph, April, 1912, N. S., vol. xxxi, p. 168). Female, fifty. Left lobe. Two pints of clear, straw-colored fluid. Entire cyst-wall dissected out and liver surfaces brought together with mattress sutures. Two stones removed from gall-bladder by cholecystostomy. Microscopic examination of cyst-wall: "One portion of the cyst-wall showed two hairs growing out and sections in this vicinity reveal the presence of stratified squamous epithelium, such as is found in the skin. The outer layer is cornified. One portion of these sections shows what appears to be a hair follicle." "Certain parts of cyst-wall undoubtedly contain teratoid tissue which makes it evident that this tumor belongs to the teratoid group." Recovered. Left hospital at end of two weeks.

41. TUFFIER, 1912 (*Bull. et mém. Soc. de chir. de Paris*, October 30, 1912, vol. xxxviii, p. 1252). Male, twenty-three. Right lobe. Cystic mass completely extirpated and hemorrhage from its bed in concave surface of liver controlled by

catgut sutures. Kidneys normal. Abdominal wall sutured with sub-hepatic drainage for forty-eight hours, when flow of a little blood and bile stopped. In excised tumor there were many cysts, completely isolated and containing different kinds of fluid, but all lined with epithelium. No hooklets or other signs of hydatid, although Parvu's complement-fixation test had been positive. Pathological diagnosis by Maute: Non-parasitic cyst of liver developed probably at the expense of the intrahepatic bile-ducts. Recovery uneventful and patient well when seen several months after operation.

42. FRITZ MUNK, 1912 (Berl. klin. Wochenschrift, 1912, vol. xlix, p. 2174). Female, forty-four. Left lobe. Somewhat thick-walled cyst, the size of a child's head. Two-stage operation: First, parietal peritoneum fixed to liver around part to be tapped; second, forty-eight hours later, cyst punctured and 300 to 400 c.c. of a greenish-gray, somewhat tenacious, slightly turbid fluid evacuated. The contents had no formed elements except blood and remained sterile on agar-plates. Four days after operation sac became infected by colon bacillus which delayed recovery. Finally, wound healed and patient was discharged. This case had been negative to the Weinberg and Ghedini's complement-fixation test with hydatid fluid. Two years after operation patient entirely free from symptoms.

43. F. A. STEENSMA, 1912 (Nederl. Tijdscher. v. Geneesk., Amst., 1912, vol. ii, p. 1209). Steensma made a chemical analysis of the contents of a simple hepatic cyst. Name of operator, method of operation and part of liver involved are not stated. Steensma says: "Solitary hepatic cysts are very rare. A comprehensive research upon the contents of such cysts has not been as yet undertaken. I had the opportunity of making one such research. At the operation, six litres of fluid were removed from the cyst. The fluid was thick and dark-brown in color."

44. SIDNEY BOYD, 1913 (The Lancet, April 5, 1913, vol. i, p. 951). Female, twenty-seven. Right lobe. Four pints of clear, mucoid, dark-green fluid, containing albumen. No sugar; no hooklets; no scolices. Incision and drainage. Operative recovery, but patient died three months after operation as the result of an unfortunate accident. The cavity had been irrigated for several weeks with a weak solution of hydrogen peroxide. On January 11, 1912 (operation had been October 9, 1911), while cavity was being irrigated, patient complained of severe pain and a little hemorrhage took place from sinus. Peritonitis followed at once and, in spite of laparotomy, patient died. Boyd thinks that the pressure, caused by the escaping gas from the hydrogen peroxide, either ruptured the sinus or tore it from the abdominal wall. Post-mortem was not allowed.

45. HENRY NORRIS, 1913 (ANNALS OF SURGERY, June, 1913, vol. lvii, No. 6, p. 805, and Trans. South. Surg. and Gynæc. Association, 1912-1913, vol. xxv, p. 410). Female, fifty-one. Left lobe. Cyst the size of a small orange. Over 200 c.c. of almost clear fluid. Incision and drainage. Cyst-wall sutured to parietal peritoneum. None of cyst-wall excised but examination of fluid entirely negative. Recovered. Drainage tract entirely closed in four weeks.

46. S. G. GRIGORYEFF, 1913 (Vrach. Gaz., St. Petersburg, 1913, vol. xx, p. 1368, p. 1408). Female, fifty-six. Right lobe. Cyst the size of a baby's head, containing transparent fluid. Part of cyst-wall removed and remaining portion fixed to the wound. A drainage tube inserted. Microscopic examination of cyst-wall: Cystadenoma of the liver. Recovered. Fistula for six months.

47. N. A. GUERKEN, 1913 (V. N. Parin, Khirurg. Arkh. Velyaminova—Weliaminoff's Archives of Surgery—St. Petersburg, 1913, vol. xxix, p. 613). Male, twenty-two. Fistula in epigastric region, for over eight years, following operation for cyst of liver at another hospital. Fistula discharged 90 to 130 c.c. per hour of a fluid containing 4 per cent. albumen, no sugar, no ferments and muco-pus. When ten years of age patient injured region of the liver by falling on a fence. The operation by Guerken was performed April 22, 1911. Cyst separated from

liver by blunt dissection and hemorrhage arrested by ligature and gauze pressure. Abdomen sutured in layers. Cyst weighed 472 grams and measured 12 x 9 x 8 cm. Grayish-white in color. Microscopic examination: lined with columnar epithelium; diagnosis, cystadenoma of liver. Patient died of shock a few hours after operation.

48. V. I. LISYANSKI and ANNA P. LYUDKEVICH, 1913 (*Russkiy Vrach.*, St. Petersburg, 1913, vol. xii, p. 18; translated into English for this article by Dr. R. Vera Zebarkes). Female, twenty-nine. Authors do not state exact part of liver whence cyst arose, but encountered "an enormous cyst of the liver, the size of a large watermelon." Cyst punctured; it contained blood. Portion of cyst-wall excised and remainder sutured to abdominal wound and drained. Microscopically, cyst contents were cellular elements of blood very little altered. Cyst-wall was composed of connective tissue, atypical liver cells and lumps of fibrin. No epithelial or endothelial cells could be detected. Authors believe that if they had been able to examine parts of cyst-wall more adjacent to the liver, they might have found small channels lined with epithelium. They also discuss possibility of pseudo-cyst from hemorrhage into the parenchyma similar to the condition which occurs in the spleen. (Reimann, Hedinger, B. K. Finkelstein.) Two months prior to her admission to the hospital patient sprained the right side of her back, but the sprain was not very severe. During first few days following operation the drainage tube discharged blood; then a yellowish fluid, apparently with traces of bile. Cavity of cyst became infected. Patient also had a transient nephritis. Fistula closed in seven months. Patient recovered completely.

49. PAYR, 1913 (*E. Sonntag, Beitr. z. klin. Chir.*, Tübing., 1913, vol. lxxxvi, p. 327). Female, twenty-five. Right lobe. Cyst the size of a small child's head. Contents not stated. Removed from liver by blunt and sharp dissection; a few ligatures used. Raw surface of liver sutured with catgut and packed with iodoform gauze, one end of which was left protruding through abdominal wound, which was sutured in layers. Three days later rubber tube substituted for the gauze. Profuse drainage of bile. Microscopically, lined with cuboidal epithelium. Pleuritis on eleventh day. On fifteenth day, 800 c.c. of serum aspirated from right pleural cavity. Rubber drain removed from abdomen in three weeks. Patient discharged from hospital in five weeks, wound being completely healed. Patient well after several months.

50. C. DUJARRIER, 1914 (*Bull. et mém. Soc. de Chir. de Paris*, 1914, N. S., vol. xl, p. 444). Female, thirty-four. Cyst which has sprung from the convex surface of the liver at the level of the insertion of the suspensory ligament. Contains a clear liquid, slightly mucous. Cyst extirpated and hemorrhage controlled by catgut sutures and pressure. Abdomen closed in layers without drainage. Pathological examination of cyst: Measurements: 9 cm. high, 5 to 6 cm. broad, and a maximum thickness of 5 cm. Microscopically, the cyst-wall was composed of fibrous tissue parallel to the surface. There was no sign of epithelium, but there was an area of disintegration which did not take most of the stains. Patient recovered. Operation, February 26, 1914; stitches removed March 5, 1914; patient left hospital March 14, 1914.

51. D. L. BORDEN, 1914 (*Virginia Medical Semi-monthly*, Richmond, March 27, 1914, p. 609, 1913-1914, vol. xviii). Female, fifty. Right lobe. There was a large cyst extending between the diaphragm and the top of the liver. There were a few cysts on the anterior surface of the right lobe. The largest cyst was opened, evacuated, and its wall sutured to the parietal peritoneum. Cyst held about 3663 c.c. of a clear, slightly yellow fluid containing considerable albumen. There were no hooklets; no sugar; no succinic acid. Recovered. Fistula drained for five weeks and then closed.

52. F. F. BURGHARD, 1914 (J. Everidge, *The Lancet*, 1914, vol. i, p. 1748). Female, sixteen. Right lobe. Fifty-six ounces of a clear, greenish fluid were aspirated. Sac was anastomosed to the most mobile part of the duodenum and wound closed without drainage. Everidge assumes "that the cyst was a diverticulum of a bile-duct." Recovered and well five months after operation.

53. M. M. ROSENSTEIN, 1914 (*Khirurgia*, Mosk., 1914, vol. xxxv, p. 52). Case I, male, forty-seven. Left lobe contained the largest cystic tumor which was totally excised. Entire liver was cystic as well as kidneys and pancreas. Drainage tube inserted under lower surface of liver and abdomen sutured. Excised tumor contained about three litres of transparent fluid. Seven per cent. albumen; no acids. Tumor was the size of a baby's head. The cysts were lined with epithelium. There were solitary cavities in the normal hepatic tissue lined with high columnar epithelium—like the epithelium of the gastro-intestinal tract of the human embryo. Patient recovered and left clinic after three weeks with wound entirely healed. The Weinberg complement-fixation test had been negative.

54. M. M. ROSENSTEIN, 1914 (*Khirurgia*, Mosk., 1914, vol. xxxv, p. 52. Case II.) Female, thirty-seven. Right lobe, about one litre of turbid fluid evacuated from the cyst cavity. Inside of the cavity could be felt several smaller cysts. Part of the cyst with the adjoining portion of the margin of the liver dissected away and the remaining portion pulled forward and fixed to the wound. A drainage tube was inserted and left in place for twelve days. Microscopically, inner surface of cyst lined with columnar epithelium. Recovered and left clinic three weeks after operation.

55. L. S. PILCHER, 1915 (*Year Book Pilcher Hospital*, Brooklyn, 1915, p. 37). Male, seventy. Right lobe. "Two quarts of limpid straw-colored fluid escaped" after puncture. Empty cyst drawn through a counter-opening in the right lumbar wall, the greater part of the sac cut away and the remnant sutured into the lumbar opening. Drainage inserted in the lumbar opening. Anterior abdominal wound closed. Uncomplicated recovery.

56. JOHN B. DEEVER, 1918 (*H. Lowenburg, Arch. Pediat.*, New York, 1918, vol. xxxv, p. 285). Male, nineteen months. "Tremendous cyst of liver." Dark, bloody fluid. Cyst incised; unilocular; walls one inch thick and did not bleed. A piece of cyst-wall excised and remainder stitched to abdominal wall; cavity packed with gauze. Pathological Report (Pfeiffer): Fluid contains neither parasites nor bacteria. Cyst-wall friable, brown in color and suggestive of a membranous lining; hemangioma of the liver. Child died a few days after operation from general asthenia.

57. ARTHUR DEAN BEVAN, 1919 (*Surgical Clinics of Chicago*, August, 1919, vol. iii, No. 4, p. 887). Female, fifty. Both right and left lobes. Large multilocular cyst. Several of the cysts punctured and fluid in all except one was clear; the fluid in this one was brown. One cyst removed for study and the others (on the surface) incised, evacuated and sutured. Kidneys, gall-bladder, pancreas, stomach and duodenum normal. Abdomen closed without drainage. Microscopic examination: Cystadenoma. Good operative recovery.

58. R. SOTO, 1919 (*Gaceta Medica de Caracas, Venezuela*, October 15, 1919, vol. xxvi, No. 19, p. 201.) Female, forty-six. The cyst pedicle was implanted in the under surface of the liver, almost in the neighborhood of the common bile-duct. Gall-bladder normal. Twelve hundred grams of purulent liquid were aspirated. Marsupialization. The character of the cyst-wall and the absence of parasites of any description made Soto place it in the non-parasitic class. In May, 1913, patient had suffered a slight trauma to this region while taking a bath. Before operation the cyst had been punctured three times. Soto thinks that the punctures infected the cyst. Drain removed five days after operation. Sinus did not heal for three months, when patient was completely restored to health.



## RETENTION CYST OF LIVER

59. ARTHUR EVANS, 1921 (British Journal of Surgery, Bristol, July, 1921, p. 155). Female, fifty-three. "A large cystic swelling was found attached to the under surface of the liver over an area of about six inches and passing back into the right paravertebral fossa." Sac resected and drained. Pathological examination (Braxton Hicks): "No scolices; no hooklets. Cyst lined with well-formed non-ciliated columnar epithelium; cystic adenoma of bile-ducts." Operation, December 1, 1919. Recovered, but sinus persisted.

60. DAVID B. ALLMAN, 1922 (Journal of the American Medical Association, May 20, 1922, vol. lxxviii, p. 1532). Female, sixty. Right lobe. Cyst about the size of a grape-fruit. About 600 c.c. of clear fluid aspirated. Carbolic acid applied to cyst-wall. Part of sac removed and remainder sutured around a rubber tube drain. Umbilical hernia repaired at same time. Neither sugar nor albumen in cyst fluid; no parasites; no ova; no hooklets. The fluid produced no growth in blood-agar or in plain bouillon. Uninterrupted recovery.

61. JOHN F. X. JONES, 1921. Female, seventeen. Left lobe. Grayish-white cyst, 19 cms. long and 10 cms. in its greatest diameter, containing 990 c.c. of what appeared to be pure green bile. Cyst, together with anterior margin of left lobe, excised. Liver sutured with catgut. Gall-bladder normal. Abdomen closed in layers without drainage. Fluid centrifuged and examined for echinococcal hooklets; none found. Cultures of this fluid sterile after ten days' incubation. Cyst lined with a single layer of low cuboidal epithelium. Diagnosis: Retention cyst of liver (J. D. Paul and Allen J. Smith). Operation, May 13, 1921. Stitches removed May 21, 1921 (healing by first intention). Patient left hospital May 29, 1921, sixteen days after operation. Last examined July 21, 1922, over fourteen months following operation, and found in good condition with no recurrence.

## COLLOID CARCINOMA

By DUNCAN PARHAM, M.D.

OF ROCHESTER, MINN.

FELLOW IN SURGERY, THE MAYO FOUNDATION

THERE has been much uncertainty concerning the subject of colloid carcinoma. Many opposing views are held of its relative malignancy, the significance of its colloid, and the source of its origin.

Colloid carcinoma has many synonymous names: mucoid carcinoma, gelatinous carcinoma, myxomatous carcinoma, carcinoma colloides, and so forth. Objection has been raised to the term *colloid cancer*, used by Virchow, because *colloid* is now used more specifically to mean the gelatinous substance containing iodine found only in the thyroid gland. Colloid is practically synonymous with gelatinous and with glutinous and is simply morphologically and microchemically descriptive of certain products of cell activity or disintegration. Mucoid is perhaps more specifically descriptive, as the particular substance found is largely composed of mucin and is modified mucus.

Colloid carcinomas may occur in almost every organ having epithelial cells normally producing, or capable of producing, mucus. They occur most commonly in the gastro-intestinal tract, stomach, large bowel, and appendix, but are occasionally met with in the gall-bladder, bronchus, breast, ovary, cervix, urinary bladder, kidney, and salivary glands.

Some differences of opinion have been expressed with regard to the origin of the gelatinous substance, but the following observations seem definitely to prove its origin from the epithelial cells of the carcinoma.

The mucinous droplets are seen arising within the protoplasm of the epithelial cells, and in adenocarcinoma they are found within the acini. Epithelial cells containing these droplets can practically always be found in the immediate vicinity of the extracellular mucin. Metastatic growths show similar mucus-containing epithelial cells, but never have colloid carcinoma cells, unless the colloid characteristics can be found in the primary growth.

A slight amount of mucus of connective-tissue origin may be present in colloid carcinoma, although it is not easily demonstrated as typical mucus. Connective tissue is rarely found; the picture is rather one of mucus forcing its way between and separating the connective-tissue fibres. Ziegler asserts that myxomatous degeneration of the connective tissue may occur in portions of a carcinoma and thus simulate true colloid carcinoma, particularly in the breast. He suggests that such growths be called *carcinoma myxomatosium*.

Epithelial mucin arises normally from all mucous membranes, and a pseudomucin is sometimes found in the ovary; at one time during the process of lactation, mucin is found in the epithelial cells of the breast. Under pathologic conditions the quantity of mucus may become largely increased. Wells says: "As epithelial mucin represents a distinct product of specialized

# COLLOID CARCINOMA

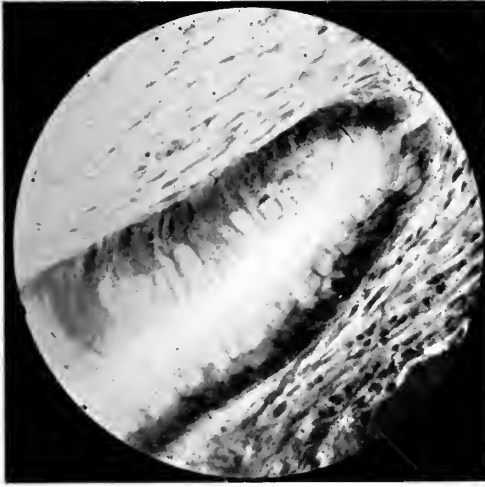


FIG. 1.—(70127). Colloid adenocarcinoma of the cæcum. Columnar type of cells with basilar nuclei and mucous formation within the protoplasm. (x250.)

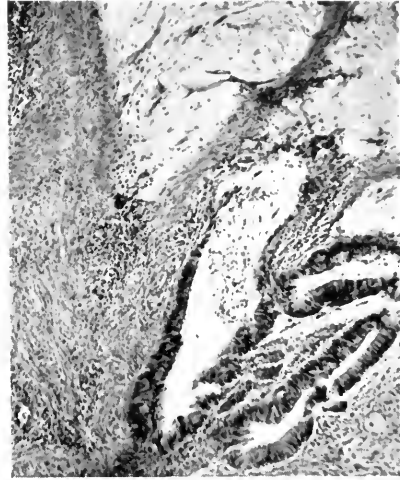


FIG. 2.—(208874). Colloid adenocarcinoma of ascending colon with columnar cells. (x50.)

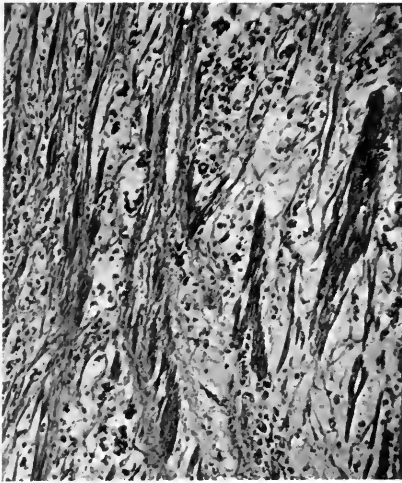


FIG. 3.—(208874). Colloid carcinoma with only slight tendency toward a sinuous formation. Same case as Figure 2 but independent lesion in cæcum 12 cm. below. (x50.)

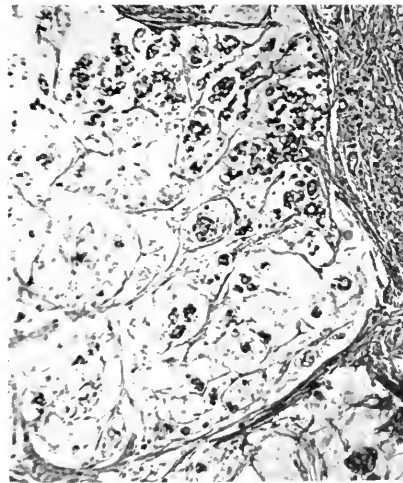


FIG. 4.—(178416). Colloid carcinoma of the cæcum. Accumulation of mucus within cells resembling signet rings. (x50.)

cells, it is questionable if the ordinary application of the term degeneration, in the sense of the conversion of cell-protoplasm into mucin, is correct. . . . Catarrhal inflammation is merely an excess of normal secretion . . . and . . . even in the extreme example of mucoid degeneration seen in carcinomas derived from mucous membranes (the so-called colloid cancers), the epithelial degeneration is not necessarily to be interpreted as a conversion of cell-cytoplasm into mucin, but is largely due to the pressure of secreted mucin upon the cells within the confined spaces of the tumor."

*Histogenesis.*—A state of confusion exists with regard to the histogenesis of colloid carcinoma. Prudden, Hamilton, Councilman and others regard colloid carcinoma as a degeneration, though perhaps by some the term is used loosely, as is *carcinomatous degeneration*. Ohlamacher compares it to fatty, hyalin, and amyloid degeneration. Adami calls it colloid degeneration, but regards the colloid as a secretion, as do Gaylord and Aschoff. Ziegler defines mucoid carcinoma as "that form of carcinoma in which the epithelial cells produce mucus or a more colloid-like gelatinous substance." He remarks: "In the intestinal cancers the formation of mucin takes place in goblet-cells, occurring under normal conditions."

Colloid formation may be manifest in the earliest stages of tumor formation. In many of the cells of most malignant tumors there are definite degenerative changes which are largely a pressure necrosis, secondary to mucoid accumulation. Other carcinomas show degenerative changes in the cells without a sign of the mucous droplets, either extracellular or intracellular. Colloid carcinomas that metastasize practically always show colloid in the metastatic growth, probably because the carcinoma is composed of colloid cells and other malignant cells not possessing the inherent characteristics necessary to produce mucus. Broders has called attention to epitheliomas composed of various degrees of differentiation. The colloid seems, therefore, to be the result of a secretory activity of the carcinoma cells and is a sign of partial differentiation.

As is expected from the rate of cellular division, colloid carcinomas are usually of slow growth in spite of the accumulation of colloid. It must also be noted that most colloid carcinomas have at least a tendency to acinar formation.

*Composition.*—The colloid material of carcinomas is a mixture of mucin and varying amounts of other proteins derived from cell disintegration and from vascular exudates. Wells writes: "Mucin in its typical form is a compound protein, consisting of a protein radical and a conjugated sulphuric acid which contains a nitrogenous sugar. Hence, when boiled with acids, mucin yields a substance reducing Fehling's solution. Mucin is acid in reaction, probably because of the presence of the sulphuric acid, and, therefore, is characterized microchemically by staining with basic dyes. It is readily dissolved in very weak alkaline solutions, is precipitated by acetic acid, and its physical properties, when in solution, are quite characteristic." In ovarian

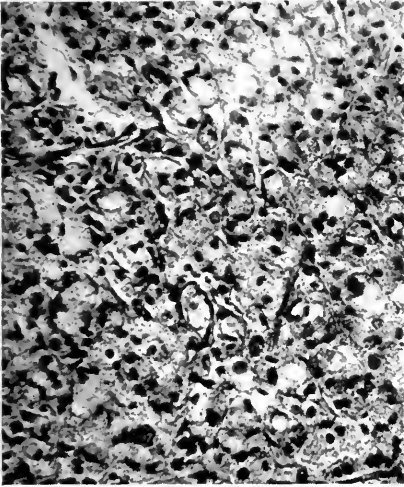


FIG. 5.—(178416). Same as Figure 4, higher magnification. (Note resemblance to hypernephroma.) (x100.)

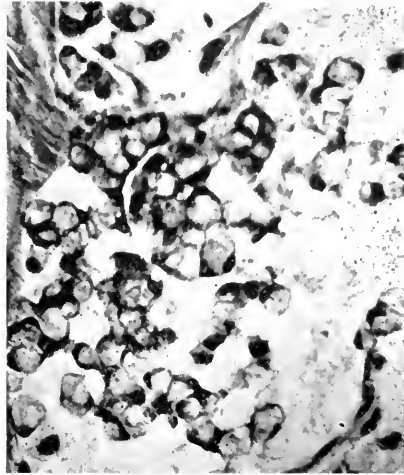


FIG. 6.—(178416). Same as Figures 4 and 5, higher magnification. (x200.)

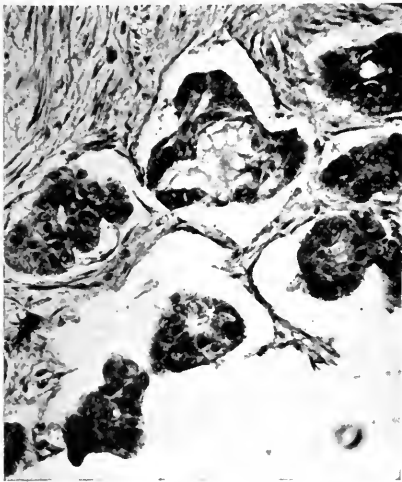


FIG. 7.—(178553). Colloid adenocarcinoma of the breast. (Note colloid material within acini and within individual cells.) (x200.)

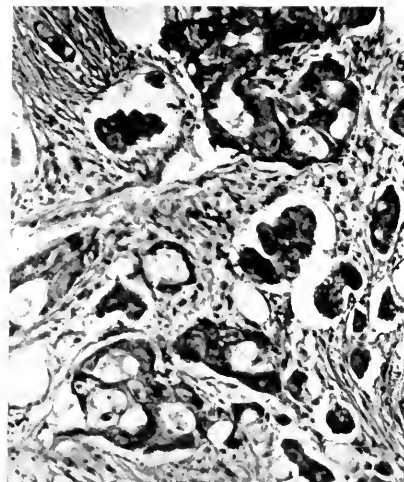


FIG. 8.—(178553). Colloid adenocarcinoma metastasis in axillary gland. Same case as Figure 7. (x100.)

tumors the colloid material contains a pseudomucin which is not precipitated by acetic acid and is alkaline in reaction.

Wells says that the presence of mucin in the tissues causes no reaction and its absorption is not harmful. Trotter, on the other hand, in examining a specimen removed from the omentum in a case of colloid carcinoma of the peritoneum, found that the colloid material had penetrated by vascular processes derived from the connective tissue of the peritoneum.

*Signs of Cellular Differentiation.*—Carcinoma tissue may or may not show other signs of cellular differentiation. Thus, the colloid characteristic may occur in various types of carcinoma: (1) simple (medullary and scirrhous) with little sign of other differentiation, (2) adenocarcinoma which may be of the small or the large and cystic type; the cells may be low cuboidal with little differentiation, or columnar with nuclei arranged orderly at the base of the cells, and (3) papillary adenoma.

The colloid material varies much in quantity. There may be small areas of colloid carcinoma surrounded by malignant cells with no sign of colloid. Sometimes the tissue is a mass of jelly-like substance replacing over large areas the cellular structure. The carcinoma cells of the colloid masses may be in "tufts" or in slightly curving rows like arcs of circles, as if the accumulating colloid within had burst large acini asunder. In other tumors the colloid may occur almost exclusively within the carcinoma cells; in some cases every carcinoma cell is overdistended with the substance, giving a signet-ring appearance. In this type there is but little tendency toward acinar formation. In some cases there are masses of colloid, each surrounded by a row of columnar cells containing colloid globules, with nuclei near the basement membrane; these are colloid adenocarcinoma with columnar cells. Colloid papillary adenocarcinoma is sometimes found.

Sometimes there is separation of types and metastatic areas differ in appearance from the primary site; however, it is noteworthy that often the metastatic process resembles the parent lesion to the minutest detail. An endeavor was made to determine the relative malignancy of the various morphologic types, especially of the signet-ring type, which is often homogeneous in appearance throughout the primary lesion and the transplants and glands. In the stomach there seemed to be no difference in mortality or longevity. In the cæcum the signet-ring type was most malignant and the colloid adenocarcinoma with columnar cells, least malignant.

Practically all colloid carcinomas show a slight tendency toward acinar formation. The signet-ring type, however, shows little acinar formation or any sign of differentiation other than colloid production, and this may explain its seeming greater malignancy in the cæcum.

*General Clinical Characteristics.*—Colloid carcinomas seem, in general, to be slower growing than carcinomas without colloid. They are slower to metastasize; there is less tendency toward fibrous encapsulation, and the carcinoma is hard to eradicate even when there is only local glandular involvement. In this respect it resembles the ependymal-cell glioma of the coccyx.

## COLLOID CARCINOMA

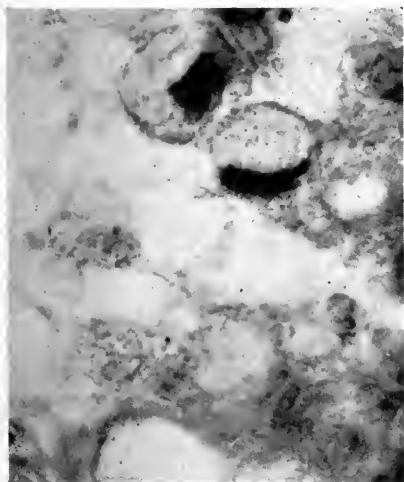


Fig. 9.—(271356). Colloid adenocarcinoma of the breast, showing colloid within cells. High power. (x1000.)

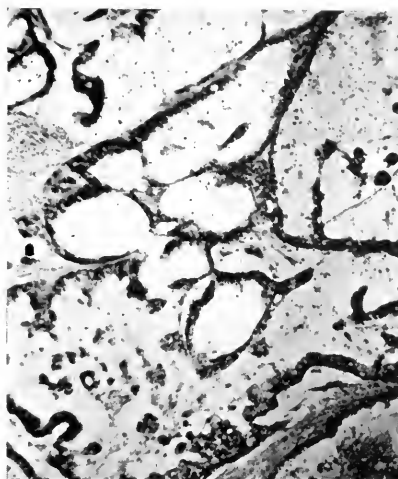


FIG. 10.—(91370). Primary colloid carcinoma of the kidney. (x50.)

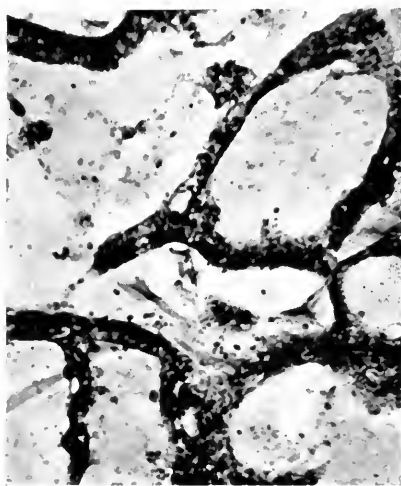


FIG. 11.—(91370). Colloid carcinoma of the kidney. Colloid arising within cells and forming large extracellular masses. (x100.)

Growth seems to be chiefly by expansion and permeation, and transplants are common. The tumor is extremely friable. In colloid carcinomas of the gastro-intestinal tract after the growth reaches the serosa, and is seen as a smooth, glistening nodule, the colloid material often breaks through, carrying with it carcinoma cells which transplant on the peritoneum, remain free in the peritoneal cavity as masses of jelly-like substance, or dense tapioca-like bodies. There is no relative difference in the age of patients with colloid carcinoma and other types of carcinoma.

Colloid carcinomas have, in general, a higher mortality than other malignant growths, but longevity is greater and metastasis later.

*Findings in 203 Patients with Colloid Carcinoma of the Gastro-intestinal Tract.*—Two hundred three patients with colloid carcinoma of the gastro-intestinal tract who were operated on at the Mayo Clinic from January 1, 1910, to January 1, 1921, form the basis of this study. Diagnosis was confirmed on pathologic examination. The cases are grouped according to the organs involved.

*Stomach.*—Colloid carcinoma of the stomach is quite common. Welch, in a review of 1221 malignant growths of the gastro-intestinal tract, found colloid carcinomas in 2.5 per cent., and von Klein, in 395, found 5 per cent.

During the period of this study, 784 carcinomas of the stomach were diagnosed in the Mayo Clinic from specimens removed at operation. Colloid carcinomas were found in fifty-one patients, thirty-seven males and fourteen females. The average age was fifty-four and seven-tenths years. Explorations were performed in eight instances and resections in forty-three; thirty patients recovered from operation. The results of treatment in twenty-three patients are shown in Table I. In nineteen patients who survived operation but died eventually, the average duration of symptoms before operation was nine and four-tenths months, and the average longevity after operation twenty-one and two-tenths months, a total duration of thirty and six-tenths months. In seven traced cases in which exploration only was done, the total duration of the disease was fifteen and two-tenths months.

All types of colloid morphology were found occurring with or without, other signs of differentiation. Almost all specimens showed slight tendency toward acinar formation. There is no definite difference in the relative mortality or longevity in the different types of colloid carcinomas of the stomach.

As compared with other types of carcinoma of the stomach, the relative frequency of colloid carcinoma of the stomach is practically the same in males and females; longevity is greater; pre-operative symptoms are practically the same and of equal duration; the average duration of pre-operative symptoms is slightly longer in cases of cure; there is little difference in the percentage of cures. Thoma says that colloid carcinoma of the stomach is more malignant than carcinoma showing no colloid change. Colloid carcinoma has a tendency to infiltrate the wall of the stomach widely and there seems to be less attempt at connective-tissue encapsulation. In certain cases the colloid cells had penetrated the whole thickness of the stomach, involving the serosa widely without



involvement of glands. Metastasis to the viscera is found less often and is relatively late; there is less tendency to early involvement of distant glands.

*Appendix.*—Four carcinomas of the appendix were found during laparotomy for other reasons. This is 7 per cent. of fifty-eight cases of carcinoma of the appendix occurring at the Mayo Clinic during the period of this study. Three patients have been heard from. Two, in whom the growth was confined to the appendix alone, are well, but in the case of the third patient, the carcinoma had ruptured and a large quantity of jelly-like material was found in the peritoneal cavity. This patient had been under Röntgen-ray treatment and was in a serious condition two years after operation.

*Cæcum and Ascending Colon.*—There were sixteen cases (22.2 per cent.) of colloid carcinoma of the cæcum in seventy-two cases of carcinoma of the cæcum and ascending colon. The average age of the patients was forty-nine years. Resection was performed in fourteen instances, exploration in one, and ileocolostomy in one. Of eight patients traced, two and one-half years after operation, three (37.5 per cent.) are alive and five are dead. Two patients had lived three and one-half years after operation.

As compared with carcinoma of the cæcum in general, colloid carcinoma of the cæcum has greater eventual mortality but greater longevity. Local glandular involvement was present in all cases except two. Colloid tumors showing cellular morphology of the signet-ring type seemed more malignant; those of the glandular type with columnar cells were least malignant.

*Transverse Colon.*—There were twelve cases of colloid carcinoma of the transverse colon in this series, 7.3 per cent. of 165 cases of carcinoma of the transverse colon. Of five patients concerning whom information was received three years after operation, three (60 per cent.) are living; one of these had glandular involvement and two did not. Both of the patients who died had glandular involvement. These few cases of colloid carcinoma of the transverse colon showed a large percentage of cures.

*Sigmoid.*—There were six cases of colloid carcinoma of the sigmoid in this series, 4.3 per cent. of 138 cases of carcinoma of the sigmoid. Information was obtained concerning three patients, all of whom were dead. Hayes, in an analysis of 100 cases of carcinoma of the large intestine at the Mayo Clinic, draws these conclusions:

1. Adenocarcinoma is present in every carcinoma which originates in the large intestine.
2. Colloid carcinoma occurs in about 16 per cent. of the cases.
3. Colloid carcinoma metastasizes and is often present in the most highly malignant cases.
4. Colloid carcinoma is very difficult to control after it begins to metastasize.
5. A very high percentage of local glands are involved in the second type of colloid carcinoma.

*Rectum and Rectosigmoid.*—The thirty-eight cases of colloid carcinoma of the rectum and rectosigmoid in this series were 5.5 per cent. of 693 cases

of carcinoma of the rectum and rectosigmoid, in which operation was performed between January 1, 1910, and January 1, 1921. Von Klein found 12.8 per cent. in seventy-eight cases.

There is little difference in the post-operative results in colloid carcinomas of the rectum and other carcinomas. As in all carcinomas of the rectum, colloid carcinomas tend to invade the glands late, and local glands are often involved long before distant glands. Metastasis to the viscera is rare and late. In cases of colloid carcinoma with glandular involvement there were three-year cures in 25 per cent.; whereas in cases without glandular involvement there were three-year cures in 43 per cent. Patients cured had symptoms longer than those who died of recurrence.

The average age of patients cured was sixty-five years, of those who died, forty-six years. Average post-operative life of patients who died, on whom resection was performed, was nineteen months, and the total duration from onset to death was thirty-two months. In cases of colloid carcinoma showing the columnar-cell adenomatous type of morphology the average post-operative life was longest.

Colloid carcinoma of the rectum seems particularly susceptible to treatment with Röntgen-ray and radium. A certain degree of gland formation could be found in practically every specimen.

Colloid carcinoma of the large intestine has a tendency to spread widely over a considerable length of the bowel; there is less tendency to stenosis in the rectum because of less connective-tissue formation. The growth is productive of large masses, often forming a thick, rigid tube; ulceration may be early and the cavity large.

*Peritoneum.*—Colloid carcinoma of the peritoneum usually presents a characteristic picture. The parietal and visceral peritoneum is studded with large and small soft glistening nodules. The cavity contains more or less jelly-like material, often round, hard, gelatinous bodies resembling tapioca or fish eggs. Adhesions may be present in abundance, matting together the intestine. The microscopic picture is one of an abundance of colloid with scarcity of cellular elements. These are usually of the columnar type and arranged in chains. Their protoplasm shows accumulating mucous droplets.

Many cases of colloid carcinoma of the peritoneum have been reported in the literature, probably all secondary to a primary growth in one of the abdominal organs. Péan applied the term, *gelatinous disease*, to the condition. Werth, in 1884, introduced the term, *pseudomyxoma peritonei*; the terms *gelatinous ascites* and *carcinomatous ascites* have also been used. Pye-Smith, in 1893, reported a celebrated case in which 299 paracenteses were performed during a period of nine years. At necropsy a papillomatous tumor of each ovary was found. Trotter, in 1910, reported a case in which the disease originated in the appendix with metastatic, gelatinous masses in the omentum, parietal peritoneum, and cæcum. The appendix could not be found. A specimen from the omentum was removed and diagnosis was made of colloid carcinoma. Many of the cells were distinctly columnar in character.

## COLLOID CARCINOMA

Nothing further was done and the patient appeared entirely well eighteen months later. Spontaneous cures have also been reported by Lejars and Eden. In the case reported by Eden, the growth was of ovarian origin. A second operation was necessary for recurrence two years later, and nearly two years after the second operation the patient was reported well. Lejars says that colloid carcinoma of the ovary is more malignant than that of the appendix. Trotter found considerable reaction to the colloid masses, which were penetrated by the connective tissue of the peritoneum, the endothelial cells often growing over the masses. He thought that perhaps the columnar cells found were of peritoneal origin. McCrae and Coplin add a case in which forty-seven paracenteses were performed during four years. At necropsy the abdomen was found filled with gelatinous material and the intestines with other abdominal viscera were matted in one mass of adhesions. The omentum was absent. The origin of the growth could not be determined. A few specimens were found showing small areas in which there were papillary growths lined by columnar epithelium containing mucoid droplets. Gelatinous nodules found between the lobes of the left lung just under the pleura were believed to be carcinomatous.

It would seem possible to tell whether these cases were of ovarian or extra-ovarian origin by chemical means. The gelatinous material produced by cells of ovarian origin contains pseudomucin, soluble in alkalin solutions, not precipitated by acetic acid and stained by acid stains. The cells arising from the gastro-intestinal tract produce mucin which is soluble in water, of alkalin reaction, precipitated by acetic acid, and stained by basic stains.

There were thirty-seven cases of colloid carcinoma of the peritoneum of uncertain origin in this series. This is 16 per cent. of a total of 232 cases of abdominal carcinoma. Of fourteen patients traced, two were living and responding remarkably well to large doses of Röntgen-ray and radium. One patient had lived eleven years since operation and twelve were dead, seven less than one year after operation, two less than two years, one less than three years, and one less than four years.

The clinical features of colloid carcinoma of the peritoneum are ascites and multiple abdominal masses. Trotter says that those of appendicular origin come under observation in four ways: (1) as an unexpected condition found at necropsy and without previous clinical symptoms; (2) as a cause of slow but pronounced abdominal enlargement; (3) as an unexpected discovery during an operation for hernia, and (4) during operation for appendicitis. In the Clinic series the diagnosis of tuberculous peritonitis was often made. The striking feature of the disease is its protracted duration and, as in two of our cases, its remarkable response to Röntgen-ray and radium.

*Gall-bladder.*—Colloid carcinoma of the gall-bladder is not uncommon. In 100 cases of carcinoma of the gall-bladder Trentlein found eight colloid carcinomas.

*Salivary Glands.*—Colloid carcinoma is occasionally found in the salivary glands. Adenocarcinomas may contain mucus within the individual cells, as

in small alveolar carcinoma, or as collections occurring in the cylindroma. The latter are not true colloid carcinomas, but rather connective tissue, mucinous, or myxomatous growths. One case of colloid carcinoma, probably arising in the salivary glands, occurred in this series. Tumors were removed at various times from the right side of the neck and infraclavicular region, right submaxillary glands, deltoid muscle, biceps muscle, forearm, and left thigh.

*Pancreas.*—Two cases of primary colloid carcinoma of the pancreas occurred in the series. A man, aged sixty-nine years, gave a history of tumor and epigastric pain of three months' duration. A large cyst containing mucinous material was found and drained. A specimen removed proved to be colloid carcinoma. Death occurred ten weeks after operation. The other case proved inoperable on exploration and the patient died within fifteen months.

*Groin.*—Two abscesses of the groin, when drained and examined microscopically, proved to be colloid carcinoma. The primary origin was probably in the colon.

*Bladder.*—Six cases of colloid carcinoma of the bladder were found, 2.5 per cent. of 241 cases of cancer of the bladder. Of six patients with colloid carcinoma of the bladder two were living, one three years and one eighteen months after operation. The average duration of life was two years. Scholl found 41.9 per cent. of patients with malignant papilloma of the bladder living three years after operation.

Colloid carcinoma (adenocarcinoma) of the bladder is somewhat more malignant than malignant papillomas and slightly less malignant than solid carcinomas of the bladder.

*Kidney.*—There was one case of colloid carcinoma of the kidney. The patient, a woman aged sixty-seven years, died one year after nephrectomy. Symptoms had appeared one year before operation.

*Prostate.*—One case of primary colloid carcinoma of the prostate occurred in the series.

*Ovary.*—There were four cases of colloid carcinoma of the ovary in the series, 1.1 per cent. of 363 ovarian carcinomas. All of these patients traced are dead.

One patient, aged forty-three years, had had symptoms for six months. At operation bilateral ovarian colloid carcinoma in cystadenomas with peritoneal involvement was found. She died eleven months after operation. One patient (Case A328293), who was operated on for colloid carcinoma in fibroma of the ovary, has not been traced. One patient, aged twenty-eight years, died with a ruptured ovarian cystadenoma and colloid carcinoma. The fourth patient, aged sixty-three years, had colloid carcinoma, probably of ovarian origin, involving the pelvic organs. She died three years and ten months after operation.

*Cervix.*—There was one case of primary colloid carcinoma of the cervix with involvement of the vagina in a woman aged sixty-one years. Symptoms

## COLLOID CARCINOMA

had persisted for two years. The condition was inoperable and repeated radium treatments were given. Two years after examination, the patient's condition was very much improved.

Colloid carcinoma of the cervix is rare. Miller collected five cases of carcinoma of the cervix in which the alveoli were filled with mucus and the stroma was unaffected. Albrecht and Cullen reported a case in which both cervix and uterus were involved. Williams suggests the origin as aberrant intestinal or ovarian glands, but this would seem less likely than an origin from the mucous glands of the cervix.

*Breast.*—There is much disagreement with regard to the origin of the mucus of colloid carcinoma of the breast. Lange regarded the colloid as arising from mucous degeneration of the connective tissue without direct participation of the cancer cells. Too much reliance cannot be placed on the toluidin stain reaction, as mucus has a complex nature which makes sharp distinctions in staining reactions impossible. Kaufmann accepts Lange's theory unreservedly. Ziegler believes the colloid arises from the cancer epithelium, but says that a mucous connective tissue is sometimes present in carcinoma of the breast; he suggests that the growth be called myxomatous carcinoma if the mucus is entirely of this origin. Borst suggests a double origin of the colloid: the connective tissue and the carcinoma cell. Mallory regards it as arising, at least in part, from the epithelial cells. Schmaus divides colloid cancer of the breast into mucoid-stroma carcinoma and colloid carcinoma. Ribbert says that, in the places where colloid formation was noticeable in its beginning, mucus was secreted into the cavity of the gland ducts, and that these mucous masses later broke through the epithelial covering, came out into the surrounding stroma, and penetrated between the connective-tissue fluids, thus loosening it and making it resemble mucous connective tissue. He says that in colloid carcinoma there is no typical mucous tissue with characteristically formed and arranged cells, but only a swelling of the connective substance. There is nothing histologically in this to point to an independent process. He, therefore, overthrows the distinction of colloid carcinoma in which the mucus is said to be derived from connective tissue and colloid carcinoma in which the mucus is said to be derived from epithelium. He maintains that there is but one source of mucus in colloid carcinoma, the epithelial cells.

In this series of cases, a definite epithelial origin was found; in no case could mucous connective tissue be made out. For carcinoma cells of the breast to produce colloid does not require so great a metamorphosis of the cell as would at first appear. Williams calls attention to the fact that, during the process of lactation, the epithelial cells of the breast at one time show mucus production. There is, on the other hand, no direct connection between lactation and the occurrence of colloid carcinoma, for it has been found in the breasts of virgins. Colloid carcinoma in the breast as elsewhere, metastasizes true to type, and colloid production seems an intrinsic characteristic of the cell. It is not, therefore, a true degeneration, but must be regarded as a

# DUNCAN PARHAM

TABLE I

*Results in Twenty-three Patients with Colloid Carcinoma of the Stomach*

	Alive and well three years or more	Dead	Recurrence
Patients with glandular involvement 15 (65 per cent.).....	4 (26.6 per cent.)	11	
Patients without glandular involvement 8 (35 per cent.).....	3 (37.5 per cent.)	4	1
Total .....	7 (30.4 per cent.)	15	1

TABLE II

*Results in Twelve Patients with Colloid Carcinoma of the Breast*

	Living and well	Living with recurrence	Dead
Patients traced ..... 12	4	2	6
Average post-operative life, years.....	2.4	1.5	3.5
Patients traced, operated on three years ago ..... 8	2	1	2
Patients with glandular involvement..... 8	2		6
Patients without glandular involvement..... 4	2		2

TABLE III

*Results in 218 Patients Operated On*

	Alive three years after operation	Alive five to eight years after operation
Patients without glandular involvement 86 (39.5 per cent.) .....	65 (75.6 per cent.)	55 (63.9 per cent.)*
Patients with glandular involvement 132 (60.5 per cent.).....	48 (36.6 per cent.)	25 (18.9 per cent.)†
Total, 218.....	113 (51.8 per cent.)	80 (36.7 per cent.)

\* Six had recurrences.

† Three had recurrence.

secretion. A few cases have been found in which the recurrent and the metastatic nodules showed no trace of colloid. Lange reported six such cases in forty-nine collected cases of colloid carcinoma of the breast. This need not necessarily be due to excessive metamorphosis, as it is regarded by Gaabe, since in many colloid carcinomas there are areas of malignant cells entirely without colloid production; the metastatic recurrence might be of these cells and not the colloid cells.

Lange, in a collection of 1814 cases of carcinoma of the breast, found the colloid type in 0.93 per cent.; later compilation of 2944 showed 1.66 per cent. Gross found 1.34 per cent.; Deaver and McFarland 1.73 per cent. There were twenty-one cases (1.12 per cent.) of colloid carcinoma in 1870 carcinomas of the breast operated on in the Mayo Clinic between January 1, 1910, and January 1, 1921 (Table II). Sistrunk and MacCarty report results in 218 cases of carcinoma of the breast (Table III). Gaabe says that the growth of colloid carcinoma of the breast is much slower and the suffering twice as great as in other types of carcinoma of the breast. The prognosis is no more favorable. Life expectancy is therefore less in colloid carcinoma than in other types of carcinoma. Less than half the patients complained of pain; in only 18 per cent. was it severe. Ulceration of the skin and metastasis to the glands occur later and in a smaller percentage of cases than in other types of carcinoma. Gaabe says that metastasis is two and one-half times as late, that late recurrence is more common, and three times as great. (Figs. I-II.)

#### CONCLUSIONS

1. In colloid carcinoma the epithelial cells possess an uncontrolled function of secreting a mucinous substance. Its accumulation is often destructive of the carcinoma cells.
2. Mucus formation is a sign of functional differentiation of the carcinoma cells, corresponding to the morphologic differentiation seen in carcinomas with cells of the acinar or columnar type.
3. The mucous-forming characteristic may be possessed by cells showing other morphologic signs of differentiation and by those not showing such differentiation.
4. Colloid carcinomas occur in the stomach (6.5 per cent.); cæcum (22.2 per cent.); appendix (7.0 per cent.); transverse colon (7.3 per cent.); sigmoid (4.3 per cent.); rectum (5.5 per cent.); pancreas (two cases); gall-bladder (8 per cent.); salivary glands (one case); bladder (2.5 per cent.); prostate (one case); kidney (one case); ovary (1.1 per cent.); and breast (1.12 per cent.). Peritoneal carcinomas occur in 16 per cent. of all cases.
5. Colloid carcinoma is usually slow of growth and late to metastasize to glands and other organs. It often grows by permeation and may cause extensive thickening of the wall of the affected organ.
6. Local glands are often involved long before metastasis has reached distant glands. Though histologically less malignant on account of permeation of adjacent tissues, it is particularly difficult to eradicate. Death is often

delayed, but the eventual mortality is greater than in other types of carcinoma.

7. Recurrence is often entirely localized to the site of origin.

8. Many patients with colloid carcinoma respond remarkably well to treatment by Röntgen-ray and radium.

# BIBLIOGRAPHY

- <sup>1</sup>Adami, J. G., and McCrea, J.: A Text-book of Pathology. Two ed. Philadelphia, Lea and Febiger, 1914, 878 pp.
- <sup>2</sup>Albrecht and Cullen: Quoted by Ewing.
- <sup>3</sup>Borst, M.: Die Lehre von den Geschwülsten. Wiesbaden, Bergman, 1902, 2 vols., 998 pp.
- <sup>4</sup>Broders, A. C.: Epithelioma of the Genito-urinary Organs. ANNALS OF SURGERY, 1922, vol. lxxv, pp. 574-603.
- <sup>5</sup>Councilman, W. T.: Pathology. Boston, Leonard, 1912, 405 pp.
- <sup>6</sup>Deaver, J. B., and McFarland, J.: The Breast, its Anomalies, its Diseases and their Treatment. Philadelphia, Blakiston's, 1917, 731 pp.
- <sup>7</sup>Delafield, F., and Prudden, T. M.: A Handbook of Pathological Anatomy, 4 ed. New York, Wm. Wood and Co., 1892, 715 pp.
- <sup>8</sup>Eden, T. W.: A Case of Pseudomyxoma of the Peritoneum Arising from Perforation of a Gelatinous Ovarian Cyst and Associated with Similar Cystic Disease of the Vermiform Appendix. Lancet, 1912, vol. ii, pp. 1498-1500.
- <sup>9</sup>Ewing, J.: Neoplastic Diseases. Philadelphia, Saunders, 1919, 1097 pp.
- <sup>10</sup>Gaabe, G.: Der Gallertkrebs der Brustdrüse. Beitr. z. klin. Chir., 1908, vol. lx, pp. 760-807.
- <sup>11</sup>Gaylord, H. R., and Aschoff, L.: The Principles of Pathological Histology. Philadelphia, Lea Brothers, 1901, 359 pp.
- <sup>12</sup>Hamilton, D. J.: A Text-book of pathology. London, Macmillan and Co., 1889, vol. i, 736 pp.
- <sup>13</sup>Hayes, J. M.: The Involvement of the Lymph-glands in Carcinoma of the Large Intestine. Minnesota Med., 1921, vol. iv, pp. 653-663.
- <sup>14</sup>Kaufmann, E.: Quoted by Gaabe.
- <sup>15</sup>von Klein: Quoted by Gaabe.
- <sup>16</sup>Lange, F.: Der Gallertkrebs der Brustdrüse. Beitr. z. klin. Chir., 1896, vol. xvi, pp. 1-60.
- <sup>17</sup>Lejars: La "maladie gélatineuse" du péritoine d'origine appendiculaire. Semaine méd., 1912, vol. xxxii, pp. 589-592.
- <sup>18</sup>McCrae, T., and Coplin, W. M. L.: Gelatinoid Carcinoma (morbus gelatinosus) of the Peritoneum. Am. Jour. Med. Sc., 1916, vol. cli, pp. 475-491.
- <sup>19</sup>Mallory, F. B.: The Principles of Pathologic Histology. Philadelphia, Saunders, 1914, 677 pp.
- <sup>20</sup>Miller: Quoted by Ewing.
- <sup>21</sup>Péan: Quoted by McCrae and Coplin.
- <sup>22</sup>Pye-Smith, P. H.: Papillomatous Tumor of Both Ovaries. Tr. Path. Soc. London, 1892-1893, vol. xlv, pp. 111-117.
- <sup>23</sup>Ribbert: Quoted by Gaabe.
- <sup>24</sup>Schmaus: Quoted by Gaabe.
- <sup>25</sup>Scholl, A. J., Jr.: Histology and Mortality in Cases of Tumor of the Bladder. Surg., Gynec. and Obst., 1922, vol. xxxiv, pp. 189-198.



## COLLOID CARCINOMA

- <sup>26</sup> Sistrunk, W. E., and MacCarty, W. C.: Life Expectancy Following Radical Amputation for Carcinoma of the Breast: a Clinical and Pathological Study of 218 Cases. *ANNALS OF SURGERY*, 1922, vol. lxxv, pp. 61-69.
- <sup>27</sup> Trentlein: Quoted by Ewing.
- <sup>28</sup> Trotter, W.: Peritoneal Pseudo-myxoma Originating from the Vermiform Appendix. *Brit. Med. Jour.*, 1910, vol. i, pp. 687-689.
- <sup>29</sup> Wells, H. G.: *Chemical Pathology*. Two ed. Philadelphia, Saunders, 1914, 614 pp.
- <sup>30</sup> Werth: Klinische und anatomische Untersuchungen zur Lehre von den Bauchgeschwülsten und der Laparotomie. *Arch. f. Gynaek.*, 1884, vol. xxiv, pp. 100-118.
- <sup>31</sup> Williams, W. R.: *The Natural History of Cancer*. New York, Wm. Wood and Co., 1908, 519 pp.
- <sup>32</sup> Ziegler, E.: *General Pathology*. New York, Wm. Wood and Co., 1908, 801 pp.

## BONE TUMORS. METASTASIS TO LUNGS FROM A PURE MYXOMA

‡ (REPRINT 115)

BY JOSEPH COLT BLOODGOOD, M.D.

OF BALTIMORE, MD.

IN the ANNALS OF SURGERY for December, 1920 (vol. lxxii, p. 713) I reported on central and periosteal myxomas and their recurrence after exploratory incision and piecemeal removal. Case II in that report (Pathol. No. 22,929), central myxoma of the astragalus, has just come under observation because of pain in the chest and elbow, and the X-ray (Fig. 1) shows shadows in the lung which are apparently metastatic tumors.

The tissue first curetted from the astragalus, the recurrent tumor in this scar, and the metastatic area in the tubercle of the tibia have the gross and microscopic appearance of a pure myxoma. There were no cellular areas resembling sarcoma.

Case I reported in the same paper, after frequent recurrences in the region of the first wound and later throughout the shaft of the humerus, died ten years after the first operation with evidence of metastasis to the lung and scalp. I have studied the gross and microscopic appearances of all the tumors in this case, and the picture remained throughout, that of a pure myxoma.

We therefore have pretty definite evidence that this type of tumor may give rise to metastasis as well as to local recurrence. The interval in the first case between the first operation and the metastasis to the lung was about ten years; in the second case, between the first operation, curetting of the astragalus, and the X-ray evidence of metastasis to the lung, four and one-half years. This is later than usual when compared with true sarcoma of bone.

Doctor Codman of Boston, in charge of the registry of bone tumors, informs me that his consulting group of pathologists is somewhat skeptical as to whether there is a true and pure myxoma of bone. The older pathologists describe it with the remark that it is a benign tumor of bone, but always recurs. Apparently they were not familiar with its metastases.

My studies of myxoma of bone first published in the December numbers of *Progressive Medicine* and later in the ANNALS OF SURGERY just referred to, and again mentioned in the *Journal of Orthopaedic Surgery* for November, 1920 (vol. ii, page 597) lead me to the conclusion that there is a pure myxoma of bone with a distinct gross and microscopic appearance. In view of the many operations in Case I and my two operations in Case II recorded in the ANNALS OF SURGERY, I have had ample opportunity to see it in the fresh and in the frozen section.

*Gross Fresh Appearance.*—When the soft-part or bone capsule of the tumor is opened, viscid gelatinous material exudes under pressure, resembling somewhat tapioca. It may be blood-stained in various shades. When the tumor is pure myxoma this gross appearance is the same throughout. In the

106<sup>a</sup>.



FIG. 1.—Skiagraph of thorax in the case of myxosarcoma of the astragalus, showing metastases in the lungs.



ANNALS OF SURGERY (*l.c.*), Figs 4, 9 and 10 picture this appearance after hardening in formalin. Formalin, however, or any other hardening agent condenses the tumor, but it still remains soft and friable.

The *frozen sections* are more characteristic than sections made after long hardening, and the gross tissue preserved in the laboratory never again shows the typical histological picture. This apparently is due to the fact that the intercellular substance contains so much fluid and so little connective tissue that it is contracted and later sections look more cellular. Figure 2 in the ANNALS OF SURGERY (*l.c.*) picture the histology in the fresh state.

As a pure tumor the myxoma is rare. It is often mixed with cartilage, but much more frequently with sarcoma.

As I read over the pathological reports of a number of pathologists, I find that *ostitis fibrosa* has now and then been diagnosed myxoma or myxosarcoma, and many pure chondromas have been diagnosed myxoma or myxochondroma. As *ostitis fibrosa* is distinctly benign and practically never recurs even after incomplete removal, and as the pure chondroma only recurs when improperly or incompletely removed, there have been a large number of cases recorded as myxochondroma and myxosarcoma which have remained well after operation, and therefore suggest to the surgeon and pathologist that it is a relatively benign tumor.

The three cases of myxoma which I have personally studied and therefore feel confident of the diagnosis and which were explored and removed piecemeal at the first operation, have all recurred. One died of metastasis after ten years, another after four years, and the third is now under observation with metastasis to the lung.

*Clinical and X-ray Diagnosis.*—If one will look at the illustrations in the ANNALS OF SURGERY and in the *Journal of Orthopædic Surgery*, one will see that there is nothing characteristic in the clinical picture or X-ray of either the periosteal or central lesion. Therefore, if one must explore in order to avoid unnecessary resection or amputation—and this is imperative, because of the common occurrence of non-malignant bone lesions—one should always bear in mind the possibility of a myxoma and there must be a devised technic to prevent, if possible, transplantation of this tumor tissue into the wound. I know of no other tumor tissue which transplants more readily than the myxoma. Up to the present time the only technic we have is the employment of the electric cautery in the exploratory incision and the use of chemical cauterization with pure carbolic followed by alcohol and a fifty per cent. solution of zinc chloride.

Up to the present time I have no more evidence than that published in the two articles referred to, and this second report on myxoma is made chiefly to record and picture the metastasis to the lung in Case II, and to again emphasize that any bone tumor which contains typical myxomatous areas is for practical purposes as malignant as a sarcoma.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting Held October 9, 1922*

The President, DR. JOHN H. JOPSON, in the Chair

## TRAUMATIC POPLITEAL ANEURISM

DR. HUBLEY R. OWEN presented a man in whom this condition had developed.

DR. A. P. C. ASHHURST raised the question whether this was really a case of traumatic popliteal aneurism. It is possible that he had the aneurism before he got hurt. If it developed after the injury, it seems more likely to be an arteriovenous fistula than an aneurism. Apparently, the examination has not been complete enough to show whether the branches of the femoral artery below the aneurism pulsate or not. From a practical point of view, he thought the thing to do was to cut down and see what it was. After three months there would have been developed a sufficient sac wall to suture, and it was quite possible that it was not the main trunk of the popliteal that was involved but a branch.

## RECURRING PERFORATIONS OF STOMACH AND DUODENUM

DR. H. A. MCKNIGHT presented a man, aged thirty-three, who was first admitted to Dr. Morris Booth Miller's service at the Polyclinic Hospital October 2, 1908, complaining of pain in the epigastrium, gaseous eructations and chronic constipation. He was operated two days after admission.

In the stomach was found a punched-out ulcer, perforated, on the lower and under side, about an inch from the pylorus. The ulcer was turned in with a purse-string suture.

The patient was again admitted to the hospital February 2, 1910, with a history that four weeks following his operation he began to have attacks in which his stomach would swell and he would suffer from pains of a sickening character in the epigastrium. The pains are very severe and last for several hours. Several hours following the acute attack he regurgitates a large amount of gas and some fluid and feels relieved. After this the pain disappears very rapidly. These attacks of pain were repeated every three or four weeks and are confined to the epigastrium. Examination at this time showed nothing but an incisional hernia in operation scar. He was again admitted to hospital January 22, 1911. He now gives a history that two months before admission symptoms became worse and he began having severe pains in the abdomen at the lower costal margin about 1.5 inches from the mid-line. These pains would last from a few minutes to several hours and were worse at night.

They were sometimes relieved by eating and sometimes followed the taking of food. Two weeks ago he began to vomit. Vomitus clear fluid. Abdomen distended with gas.

At operation, January 23, 1911, the pylorus was found almost occluded by old scar. The posterior wall of stomach was exposed in the usual manner and a posterior gastro-enterostomy performed. Hernias repaired. The next hospital record of this patient is March 1, 1920, when he was admitted for one day with a diagnosis of acute indigestion. He was admitted again January 1, 1921, with a diagnosis of gastropnoia and partial closure of the gastro-enterostomy stoma. He gives a history of pain in the epigastrium, diarrhoea and abdominal distention.

X-ray examination, marked gastrectasis and retention of about one-fourth of the opaque meal at the end of twenty-four hours. No evidence of gastro-enterostomy. No evidence of carcinoma, though the pylorus could not be clearly defined because of a very large stomach. Obstruction most likely due to the cicatrix of an old ulcer.

January 21, 1921, the abdomen was reopened through an upper right rectus incision; gastro-enterostomy opening enlarged. A Rovsing gastropexy performed and the greater curvature of the stomach sewed to the anterior abdominal wall. Stomach was opened but no evidence of ulcers found. Patient felt fine until March 23, 1921, except for an occasional pain in the epigastrium. He was admitted to the hospital March 23, 1921, with the history that he ate his lunch and felt all right; three hours later he began to feel bloated in the upper abdomen and to have severe pain in the epigastrium. He did not vomit until medicine was given. He was admitted about eight hours after onset of symptoms in great pain and shock with a board-like rigidity of the upper abdomen, and enormous distention.

Operation performed at once. Upper right rectus incision. On opening the peritoneum a large amount of air escaped. The peritoneal cavity was full of fluid. There were many dense adhesions between the stomach and the anterior abdominal wall the result of the suspension. The stomach was also adherent to all surrounding structures: liver, gall-bladder, colon, etc. Due to the plication of the stomach it was with great difficulty delivered, but on delivery a small perforated ulcer was found on the anterior surface of the stomach near the greater curvature and toward the cardia. It was quite some distance from the gastro-enterostomy, which was found patulous, no other ulcers were discovered involving the gastro-enterostomy or jejunum. The perforation was closed with a purse-string, oversewed with chromic gut, the adhesions were released, the omentum was tacked over the ulcer, and the pelvis drained. A culture from the peritoneum showed bacillus coli and streptococci. He was discharged February 6th from the hospital in good condition. On April 22, 1921, he was free from pain or discomfort. On this date another X-ray was taken, which showed a patulous gastro-enterostomy at the junction of the lower and middle thirds of the posterior surface. No evidence of a patulous pylorus. This part of the stomach ends abruptly. It is very smooth and regular. There is very marked and exaggerated peristalsis quite irregular with deep incisura and persistent

in the lesser curvature directly opposite the enterostomy. No filling defect may be due to spastic condition of stomach.

On May 18, 1922, at 6 A.M., while moving in bed patient had a sharp pain in the upper abdomen. The abdomen suddenly became distended. He was brought to the hospital at 8 P.M. Examination revealed a markedly distended abdomen tympanic all over. Pulse good, no shock, no temperature. Again the abdomen was opened; a large amount of fluid and air was found in the peritoneal cavity, with much plastic lymph and reddening and agglutination of the intestines. Stomach was inspected, no opening found. The gastrohepatic omentum was opened and a perforated ulcer found on the posterior wall of the stomach at about the middle of the organ. The lesser peritoneal cavity contained fluid. The perforation was closed with a purse-string suture of chromic gut and a cigarette drain was placed in the lesser peritoneum and pelvis.

Patient reacted very well, but after twenty-four hours showed signs of a diffuse peritonitis and died May 21, 1922, three days after onset of attack.

#### PERFORATING WOUND OF THE KIDNEY WITH SECONDARY NEPHRECTOMY

DR. H. A. McKNIGHT reported the history of a case, premising by saying that incised or punctured wounds of the kidney are relatively rare, only about 200 cases have been reported, and the large majority of these are gunshot wounds and therefore are not true stab wounds.

Keen in 1896 collected 155 cases of injury to the kidney, and of these only 8 were penetrating and caused by direct stabbing. Keen also quotes Küster, who in 7741 injuries seen in the clinics of Basel and Berlin, could tabulate only ten cases of this character or about one in a thousand, and of these ten, only one was an open wound; of 2610 autopsies at the same clinics there were 13 injuries of the kidney and only one of a penetrating nature.

The case he had to report was a stab wound of the left kidney, with secondary operation about two months after the primary operation in a patient with a hæmoglobin of 12 per cent. and a pyonephrosis.

The youth, aged fifteen years, was admitted to St. Mary's Hospital May 4, 1921, after having been transported in an automobile hearse from a nearby town. He had been stabbed by another boy with a carving tool, and on admission was bleeding profusely from a wound in the loin over the left kidney. He passed bloody urine frequently and complained of pain in the loin and over the bladder region. He was operated the next day by the surgeon on service.

The kidney was exposed by a loin incision over the wound, and was found to be punctured in the lower pole on its posterior surface with a grooved wound of the cortical substance. The capsule was loosened, raised and separated for a considerable distance by extravasated blood. The bleeding was slight, and as no urine was seen flowing from the puncture, the capsule was sutured and the wound packed with gauze.

The patient reacted well from the operation, but for several days continued to pass bloody urine which finally became clear. Two weeks



after the operation he was up in a chair and three days later was up and around. The next day, however, he was suddenly seized with a sharp pain in the loin and again passed bloody urine. This condition continued. One week after operation his blood count was: reds, 1,959,000; whites, 7600; hæmoglobin, 38 per cent. On May 25th, he had a red count of 2,080,000 and 30 per cent. hæmoglobin. His blood count continued at about these figures until July 1st, one month after his injury, when he came under the care of the reporter. He now had a blood count of 1,720,000 reds, 4000 whites, and a hæmoglobin of 30 per cent., with nucleated reds, transitional cells, polychromatophilia and poikilocytosis. On July 17th, his reds had dropped to 1,390,000 and his hæmoglobin to 20 per cent.

All this time the patient had been passing blood in his urine, and at times following a severe pain in the loin, would pass complete blood casts of the ureter six to eight inches in length. He had been running a normal temperature up to this time, but suddenly his temperature rose to 104° and his white cells to 10,600 and hæmoglobin dropped to 15 per cent.

On July 20th, he was transfused with 800 c.c. of blood taken from his assailant, a boy of twelve years. His hæmoglobin now rose to 25 per cent.

One week later he had a red count of 1,150,000, a white of 24,000, and a hæmoglobin of 12 per cent. The kidney was now exposed under a very light ether anæsthesia. Many adhesions were encountered, and when the kidney was separated a large amount of pus was found internal to the organ and surrounding the pedicle, which bridged the abscess cavity. A Wertheim clamp was placed on the pedicle, but when tightened cut completely through it due to the softened and necrotic condition of the tissues. Six large clamps were applied to the stump, only a small amount of blood being lost, and the wound was packed with gauze and the patient returned to bed. The clamps were removed in five days and a light gauze packing placed in the wound.

He was discharged from the hospital October 3rd, four months after his injury with a hæmoglobin of 75 per cent. and his wound completely healed.

The removed kidney showed a perforation at the lower pole just below the middle of the organ, which extends in an upward direction, perforating the anterior surface at a higher level. On section there is found a large white organized clot about one inch in diameter involving the cortex and extending down to the pelvis; this clot is surrounded by a red clot about one-quarter inch thick.

DR. JOHN H. JOPSON said he had operated on two cases of wounds of the kidney, due to high explosives; both required nephrectomy. One was a young man, whom he had showed before the Academy, where removal of the kidney was performed, a wound of the liver packed, and the patient recovered after a secondary empyema. The other case died of an associated wound of the liver, which is common. In both of these cases a nephrectomy was indicated due to the laceration of the kidney on the right side.

DR. D. L. DESPARD said that recently he had had three cases of very diffuse hemorrhage from the kidney due to trauma, but in no case was there a wound. In one he had to open the abdomen on account of a ruptured spleen, and he had a chance to observe the tremendous hemorrhage which took place in the retroperitoneum as a result of the wound to the kidney. One case, a boy of eighteen years, bled very profusely from a ruptured spleen, and on opening the abdomen there was an extensive retroperitoneal hæmatoma. The boy's condition did not justify the removal of the kidney. In neither of the other two cases was any exploration of the abdomen made; the injury to the kidney was made evident with profuse bleeding through the bladder.

DR. JOHN F. X. JONES read a paper with the above title, for which see page 68.

ABSTRACT OF PAPER BY DR. DONALD GUTHRIE ON "PRACTICAL HOSPITAL PSYCHOLOGY"

DR. DONALD GUTHRIE, of Sayre, Pa., read a paper with the above title. He premised by saying that one of the chief causes of post-operative psychosis in the surgical patient is poor anæsthesia. He laid special stress on the advisability of having anæsthetics given by those competent and well trained. The anæsthetist should be a skilled psychologist and have a personality which can readily apply different kinds of suggestion to different individuals. At the beginning of any anæsthetic—chloroform, ether, nitrous oxid—a mixture of eight parts of suggestion and two parts anæsthetic is the best one known. If the fears of the patient can quickly be allayed by a constant stream of suggestion she will no doubt go to sleep quietly and recover from the anæsthetic in the same state of mind. The older text-books of surgery show cuts illustrating the stage of excitement during the anæsthesia. The services of five or six of the strongest helpers in the hospital were enlisted to control the patient during this period. These terror-stricken individuals invariably woke up in just the same frame of mind in which they went to sleep—kicking, struggling, screaming, and trying to flee from something terrible. Is it any wonder that these frightened, starved, dehydrated, strychnined-lashed patients had anything but a horror of our hospitals? The writer may be wrong in his belief that the subconscious mind goes to sleep last and is the first to recover in anæsthesia, but there is much evidence to support it.

The anæsthetist is the most valuable member of the operating team, and if properly trained and with the right personality, can do more to rob the surgical patient's mind of fear than anyone else.

Can anyone witness the successful anæsthetizing of young children and see child after child put to sleep without crying, without struggling, without fright, and not admire the great skill that is being shown in suggestion and hypnotism; and, after seeing a screaming, struggling child asphyxiated by a poor anæsthetist, who of us is in the position to say just how much or of what type of future mental ill health may have its origin in the fright caused by this bad anæsthesia?

For the past two years he had been using music during anæsthesia to a great deal of advantage. He had an old-fashioned sweet-toned music-box in use while children were being anæsthetized with ether. It has been remarkable to see how the music attracts the child's attention and enables the anæsthetist to put children to sleep without fright. He also uses music during the recovery from nitrous oxid and oxygen anæsthesia. When the operation is completed and the patient allowed to wake up absolute quiet is maintained. Excitement during the recovery from nitrous oxid and oxygen anæsthesia, which is so common, is greatly lessened—in fact many patients will pass into a natural sleep, and he had had many of them speak of the delightful sensations the music seems to have caused during the awakening period.

It is important to have the patient recover quietly from the anæsthetic in a recovery room. She must be administered to by a nurse who has been specially trained and who will assure her that the operation has been successfully performed and that her condition is excellent. Quiet, calm assurance at this time that everything is as it should be works better than sedatives, although it is essential that immediate post-operative suffering be controlled by morphine. He gives frequent doses of morphine for the first two or three days, and large amounts of fluids by mouth and rectum soon after operation. Everything possible is done for the comfort of these patients. After operation nurses are with them constantly and they have frequent visits from the surgical staff. The apprehensive patient who is allowed to suffer cannot be convinced that her condition is satisfactory—it is far from being so to her—and she fears an unsatisfactory or fatal outcome. The services of a corps of efficient, loyal, well-trained nurses, who love their work, and who look upon it as an art and not a trade, at this time are indispensable.

DR. H. K. MOHLER said that the hospital personnel needs to hear very frequently these points emphasized in Doctor Guthrie's paper. Nothing could do more towards improving the treatment rendered by a hospital to its patients than to require everyone who has to do with a surgical patient, to undergo an abdominal operation about once every two years. It is true that an anæsthetist who has taken an anæsthetic, all other things being equal, is a better anæsthetist than one who has not taken an anæsthetic.

The question of convalescence is one not thought of enough, and deserves greater consideration than it has received, both from the standpoint of the patient and the hospital. As soon as it is safe to move a patient he should be transferred to more pleasant and cheerful surroundings than exist in a surgical ward in the hospital. By this Doctor Mohler means preferably to a convalescent home, and incidentally it should be a home for convalescents and not for incurables. The atmosphere of this home must be one of cheer and sunshine. The transference of patients to a convalescent home as early as their condition will permit will release surgical beds which are so urgently needed in almost every large hospital at certain seasons of the year. Convalescent homes are economical both to the patient and to the hospital.

More cordial relations between attending physicians and the patients will often result in better results. Recently a surgeon told Doctor Mohler of several patients which were greatly benefited by conversation with their surgeon, who convinced them that their limitation in motion of the arms was not as great as the patient imagined. Less than five minutes talk by the surgeon resulted in the patient developing more motion in his recently healed fracture of the forearm than he believed he would ever attain.

DR. D. J. MCCARTHY said he thought the important matter to consider was whether the method put into effect by Doctor Guthrie at Sayre could not be done equally well here in the Philadelphia hospitals. Doctor McCarthy said he did not know of any better illustration than what had been accomplished in the psychopathic wards at Blockley. He said they used to be frightful, but the kindly attitude of the new chief, Doctor Ebaugh, had transformed them into as pleasant a place as it was possible for these patients to be. How would be the best way to apply Doctor Guthrie's principles to large city hospitals, like the University and Jefferson. The responsibility rests with the directors of the hospital, the staff, and they should be made individually responsible for the attitude and conduct of their department of the hospital. Doctor McCarthy said that in his hospital services he always made it a point to specially instruct his people that if a patient complained about treatment, about the bill, etc., every effort should be made to have things corrected or adjusted to suit the patient so that he will want to come back to the hospital and that service.

As to the psychopathic ward, Doctor McCarthy said there was no question at all as to the merit of the suggestion Doctor Guthrie had made. If you have a nervous patient who has never before been to the hospital and if he or she has to wait in the reception room for hours before being taken care of, the patient becomes very dissatisfied, and in some cases may leave the hospital before being admitted to the private room or ward.

He thought the nursing situation was a serious one, and that in psychopathic work especially it was especially essential to have nurses who were properly trained to meet patients, since one without proper training may undo in a few minutes the work which it has taken months to do.

When it was necessary to do a minor operation on a very nervous patient, he would rather not take it to the operating room, but take the chance of infection in the patient's room than have the patient scared to death. It was the neurologists who got the results of the surgical operations,—the post-operative neurasthenics; many times not because the surgeon had failed in his operation but because the preparation and post-operative treatment of the patient had not been properly followed out.

Doctor McCarthy said that he believed that all of Doctor Guthrie's suggestions could be applied to a large city hospital just as well as to a small hospital, but that it would take time and trouble. In most cases it would mean doing to the hospital what the manager does to a hotel if he wants to make it first class; reorganizing from the door all the way through the hospital.



a



b



c

FIG. 1.—Old compound depressed fracture of the frontal bone: a and b, before transplantation of cartilage; c, after transplantation.



# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting Held October 11, 1922*

The President, DR. JOHN A. HARTWELL, in the Chair

## TRANSPLANTATION OF COSTAL CARTILAGES FOR DEPRESSED FRACTURE OF FRONTAL BONE

DR. CLARENCE A. McWILLIAMS reported the case of a miner, aged thirty, who was referred by Doctor Downes, and admitted to the Skin and Cancer Hospital, September 10, 1922, with a marked depression in the left frontal region, extending to the mid-line above the root of the nose, one and one-half inches to the left and down through the supraorbital ridge. The deformity was very marked and there was a partial ptosis of the left, upper eyelid (Fig. 1, a). The history was that in June last he was injured by a fall of slate in a mine producing a compound, depressed, lacerated skull fracture, filled with dirt. He was operated upon in a hospital in West Virginia, the wound was cleaned and spicules of bone removed. The healing was by primary union. When seen by the reporter there was a Y-scar in the centre of the forehead depression where there was cerebral pulsation. He begged to have his deformity relieved, though there were no subjective cerebral symptoms of any kind. So operation was performed on September 14, 1922, under Gwathmey colonic anæsthesia which is the method of anæsthesia employed in the Skin and Cancer Hospital for all head and neck operations. This is a great advance over all methods of inhalation anæsthesia, and we have yet to see an untoward effect from it, and our series of cases using it is large. The Y-incision was opened without going through any unscarred territory. The skin was elevated and it was found that both walls of the frontal sinus were gone, the brain, covered by a fibrous membrane, pulsating at its depth. The bony edges of the depression were freshened, and from the lower right costal arch were removed three pieces of cartilage with perichondrium on one side, whose edges were beveled, and these strips were fitted into the depression, edge to edge, the lowermost strip being curved so as to round out the supraorbital ridge. The strips were sewn in place at their ends by plain catgut. Cartilage was preferred to bone to fill out the depression because:

1. Cartilage is more easy to whittle into any desired shape.
2. Cartilage withstands infection better than transplanted bone. Infection in this region might prove serious. Necrosis of cartilage the result of infection is never as extensive as in a graft of bone.
3. Transplanted cartilage remains permanently in place while probably most transplanted bone undergoes absorption and replacement. No drainage

was used and the wound was sewn up by interrupted silk sutures. The union was by primary intention in both the forehead and the chest. The cosmetic result was excellent. (Fig. 1, c.)

## COMPLETE RHINOPLASTY BY CARTILAGE TRANSPLANT AND PEDICLED TEMPORAL FOREHEAD FLAP

DR. CLARENCE A. McWILLIAMS presented a girl twenty-two years of age who was cured four years ago of lupus of the face after six years of treatment at the Skin and Cancer Hospital. In January, 1922, she went to Doctor McWilliams to have her deformed nose rectified, if possible. All the cartilages of the nose were gone and there was a large perforation of the septum at its lowest part. The nose was level with the face and the nostrils looked upward. The skin of the nose was scarred deeply. Dr. V. Mitchell took a plaster cast of the face and nose. On this cast was built up of wax a suitable nose. A strip of tinfoil was laid over the new nose and extended over to the right temporal region, its base just above the ear so as to include the anterior temporal artery. This should represent the future temporal flap in the hair line, and was cut just of the right shape.

The patient was anesthetized with the Gwathmey colonic anesthesia. After the first anesthesia, which was perfect, she would have no other method of anesthesia. Three times she was thus anesthetized and all worked perfectly. The first procedure was to transplant a piece of costal cartilage between the skin and pericranium in the exact spot in the frontal region in the hair line as measured on the overlaid pattern of tinfoil. This was left undisturbed for two weeks. Then the flap was marked out extending over to the ear and its outer half was tubed; that is, its edges were sutured together. The portion to form the future nose was cut down to bone through the pericranium, except above where it was left uncut to form the hinge upon which the flap was lifted up. The under-surface of the pericranium was Thiersch skin grafted and the flap sutured in place and was left undisturbed for two weeks. Primary union resulted. Then the hinge was divided, freeing the whole flap containing cartilage with skin under surface. The scar tissue of the nose was removed into the nasal cavity, the columella was divided above and the forehead flap pedicled above the ear was brought down and fitted into the nose. The raw columella edge was sutured to the raw area of this flap. For two weeks the flap was left undisturbed. Then it was divided close to the ala and sutured to the freshened nasal edge. The severed outer portion of flap was then replaced in the freshened temporal defect and the raw area in the forehead, made by taking skin for the nose, was skin grafted. Primary union resulted throughout and the final cosmetic result is excellent. The hair on the new nose has been removed by X-rays, applications once a month for six months being necessary to permanently kill hair.

## COLONIC ANÆSTHESIA

DR. JOHN A. HARTWELL expressed a desire to know whether all the members of the Society were as enthusiastic about colonic anesthetization as Doctor McWilliams seemed to be. He said that there is a general impression that



it is not as safe as inhalation anæsthesia, and he thought it would be well for the members to discuss it before letting it go unqualifiedly that it is without danger.

DR. EDWARD W. PETERSON said that he had used oil-ether rectal anæsthesia in œsophageal diverticula operations with happy results.

DR. H. H. M. LYLE said that he had used colonic anæsthesia extensively and thought it had its advantages, but he was not sure that it is absolutely safe. He was open to proof either way. He had seen one or two cases in which he had his doubts whether it had not something to do with the patient's death.

DR. CARL EGGERS said he had used colonic anæsthesia as advocated by Doctor Gwathmey, in suitable cases, both at the Lenox Hill and the New York Skin and Cancer Hospital. It is not alone a question whether colonic anæsthesia in general is a safe anæsthesia, but whether it is a safe anæsthesia in those cases in which it is specially indicated. It seems unscientific to inject a fixed amount of ether, the rate of absorption of which one is unable to control. In practice, however, it works out very satisfactorily. By mixing the ether with oil, it is absorbed but slowly and one can usually recover part of the mixture, should it become necessary.

Some years ago when larger amounts of ether were still being used, Doctor Eggers had a death in a young man who had been operated upon for sarcoma of the superior maxilla, who during the operation began to do poorly. He tried to recover the ether mixture, but was not successful. The patient was returned to bed in bad condition. He tried everything to overcome the deep ether anæsthesia, but was unable to prevent a fatal outcome. He had had one other bad result in a patient with chronic empyema. In addition to colonic anæsthesia he was given 300 c.c. of 4 per cent. magnesium sulphate solution by hypodermoclysis. This patient never recovered complete consciousness and died after twenty-four hours. He was autopsied. The wound was allright, but there was œdema and interstitial hemorrhages into the lung, sanguineous fluid in the thorax and an acute exacerbation of a chronic nephritis. The findings were attributed to the anæsthesia. Doctor Eggers did not think Doctor Gwathmey uses this combination at present. The administration of small amounts of ether in oil (4 oz.), as practiced at present gives excellent results, and in head and mouth cases seems an ideal anæsthetic.

It is the speaker's belief that patients with a patent ileocæcal valve are not suited for this form of anæsthesia, because in them the ether oil mixture may pass into a part of the intestines from which it can not be recovered.

DR. J. I. RUSSELL asked if when this form of anæsthesia was used, whether there was any proctitis or colitis following, and whether the patient was relieved of the nausea which follows inhalation anæsthesia.

DR. ROBERT T. MORRIS remarked that a notable degree of relaxation of the abdominal muscles belongs to colonic anæsthetization. The method has peculiar advantages also in cases of bronchiectasis, bronchitis, and pulmonary tuberculosis.

DR. CLARENCE A. McWILLIAMS, in closing the discussion, declared that he was greatly surprised at the results of colonic anæsthetization when he first went to the Skin and Cancer Hospital, but now he uses it with the same confidence that he does inhalation anæsthesia. Very little ether is used, on the average only about four ounces, and the result is that one can use it routinely with confidence and recommend it to anyone who has to do face or neck operations. Smaller and smaller amounts of ether have been used and the routine is now four ounces, with proportionately smaller amounts in smaller individuals. As to Doctor Lyle's doubts whether it might not be held responsible for the death of one or two of his patients, the same might be said for inhalation anæsthesia. In reply to Doctor Russell regarding nausea and vomiting, there is almost no vomiting, usually once at the most. The comfort it gives to the patient is very great. The degree of analgesia with semi-consciousness is high as compared with the complete unconsciousness of inhalation anæsthesia. If one avoids rough handling of tissues and loss of blood, one can operate without shock for from four to five hours, as may be required in extensive node dissections of neck. There is a hospital in Virginia where it is routinely used, and the number of their cases is now over 2000 with colonic anæsthesia. Their mortality is no higher than previously with inhalation anæsthesia. Of course it should be used with care, and the method not changed or experimented with.

#### RECURRENT DISLOCATION OF SHOULDER

DR. JOHN A. HARTWELL presented a man who had been operated upon eleven years previously for a recurrent dislocation of the shoulder. The patient at the time of operation was fifty years old and gave a history that he had dislocated his shoulder twenty-five years previously while at sea. Reduction was not done until two days later. Following that time the shoulder had repeatedly been dislocated with very slight cause. Dislocation had taken place four times during the three months previous to admission. The shoulder was dislocated at the time of admission, it having been thrown out a few hours earlier while simply elevating his hand above his head. The dislocation is of the subcoracoid type.

Operation performed the same day. Incision was made along the anterior margin of the deltoid from the coracoid process over the greater tuberosity outward onto the arm. The incision was carried down to the capsule. The structures were retracted so as to completely expose the capsule on its anterior aspect. No positive pathology was demonstrated. A long incision was made in the capsule from the glenoid downward and outward to its insertion into the neck of the humerus. The inner lip of this incision was then lapped over the outer lip for a distance of one-half inch and sutured in that position to the external surface of the capsule by three mattress sutures of plain catgut. External wound was then closed without drainage and the arm placed in a Velpeau dressing.

Primary union took place and the patient left the hospital in about two weeks. He started to work as a coal shoveler three weeks after the operation and has been engaged in this work ever since. There has

## RECURRENT DISLOCATION OF SHOULDER

never been a recurrence of the dislocation and he has suffered absolutely no disability in the way of restricted movement at the shoulder joint.

In a second case a different procedure had been followed. The patient was admitted to the hospital on October 28, 1921, and discharged on November 14, 1921. He gave a history of first having dislocated his shoulder nine months previously following a fall, the exact nature of which was not disclosed. Since that time frequent dislocations have taken place from trivial exertion, three such dislocations having occurred during the week preceding his admission. At the time of admission the humerus was in normal position. Patient stated that when dislocation took place the arm was held close to the body with internal rotation, and that the head of the humerus appeared upward and posteriorly under the spine of the scapula. In other words, a sub-spinous dislocation. This seemed so doubtful that the patient was requested to produce a dislocation before the anæsthetic was administered. This he did by throwing his arm suddenly upward and outward, when a typical sub-coracoid dislocation took place, which he stated was the same dislocation that he had previously described as being of quite a different nature. He was immediately anæsthetized and an attempt made to keep the dislocation until the incision should reveal its exact pathology. Immediately on the relaxation of the muscle, however, the head dropped back into its normal position. An incision was made 15 cm. in length beginning at a point over the junction of the outer and middle third of the clavicle and following the contour of the shoulder over the anterior third of the deltoid. The fibres of the deltoid were separated and some of the fibres of its clavicular origin divided. By dividing the fibres of the tendon of insertion of the subscapularis, the antero-internal aspect of the capsule was reached. The capsule was opened longitudinally just internal to the biceps tendons, revealing a large tear in the capsule at its interno-inferior junction about one inch from the attachment of the capsule to the neck of the humerus. Working through the artificial opening, three sutures of No. 2 chromic catgut were used to completely close the tear. The operative incision was closed with four sutures of No. 2 chromic catgut and the divided fibres of the subscapularis repaired at the same time. The separated fibres of the deltoid were loosely approximated, a rubber dam drain was placed in the dependent angle of the wound and the skin incision closed with six sutures of silkworm gut. Dry immobilizing dressing applied. Patient sent to ward in good condition.

This approach to a capsular tear in this location was very satisfactory, the sutures being placed without undue difficulty. It has the disadvantages of adding a possible danger of joint infection and of having the tie of the suture within the joint. This, however, may prove an advantage in causing adhesions which will limit somewhat motion and thus help prevent recurrence.

Primary union took place except for a little sero-purulent discharge from the skin wound, culture from which was sterile. Following the operation the patient was instructed to use his arm as much as

possible, only avoiding exaggerated movements of external rotation and abduction.

At the time of discharge, sixteen days post-operation, movement in all directions was approximately two-thirds of the normal. He was last seen on May 7, 1922, up to which time there had been no return of the dislocation. He was doing hard work as a laborer and there was no restriction of motion. So far as Doctor Hartwell is aware this method of repairing a tear in the capsule of the shoulder joint had not been employed. He felt that it was of distinct advantage over other methods of repair in that being inspected from within the capsular rent was very easily seen and accurately closed, which is often very difficult to do when one is working from the external surface of the capsule.

THE EFFICIENT TREATMENT OF ACUTE AND CHRONIC, SIMPLE, TRAUMATIC SYNOVITIS (HÆMARTHROSES AND HYDARTHROSES) BY REPEATED ASPIRATIONS AND IMMEDIATE ACTIVE MOBILIZATIONS WITHOUT SPLINTING

DR. CLARENCE A. McWILLIAMS read a paper with the above title, for which see vol. lxxvi, page 677.

DR. ROBERT T. MORRIS said that sometimes the tissues about the joint are painfully distended with serous infiltrates, particularly in the chronic cases. In addition to aspiration, he injects a solution consisting of one part boro-glyceride, three parts glycerin, and four parts physiologic saline solution, sending it back through the same needle. This being hygroscopic has the effect of unloading serous infiltrate from the fibrous tissues around the joint by rapid exmosis. Doctor McWilliams referred to the quickness with which these patients get about after aspiration of joints; the speaker had also found that patients wanted to get right out of bed, and he was convinced that one may safely let them get up quickly as a rule.

DR. ROYAL WHITMAN said that the quotation Doctor McWilliams had read from his (Doctor Whitman's) book, namely, that aspiration was always indicated if the tension of the effused fluid caused discomfort, and that functional use was to be encouraged if the joint could be protected by adhesive plaster strapping, made it evident that he was not to be classed with those writers who advocated indefinite fixation in splints regardless of the effusion. Synovitis at the knee or other joint was a symptom of injury, and he could not therefore admit that evacuation of the effusion and immediate functional use was a specific remedy for all cases. Certainly not for a crushed or displaced cartilage, or ruptured lateral ligament. Even in the illustrated case in which blood was removed at repeated examinations and in which there was elevation of bodily temperature, it seemed to him that rest and compression for a few days was indicated rather than enforced function. While, therefore, he was in accord with the principles advocated by Doctor McWilliams, he thought these principles should be applied with discretion and discrimination.

DR. GEORGE WOOLSEY considered that Doctor McWilliams was a little radical. Aspiration should depend somewhat on the amount of fluid. In

many cases of traumatic synovitis the patient could be made very comfortable by strapping and allowing him to go about at once. Aspiration is not, therefore, always a necessity, and if it is not necessary it should be avoided. There are cases where aspiration is very valuable, but that it should be pronounced a rigorous necessity in all cases would seem questionable. It depends also on the joint. The knee joint is very readily aspirated, but in other joints it is not so easy. Mobilization is proper in all cases. The speaker had used it for many years in cases where the injury went beyond a sprain and produced a peri-articular fracture. He showed a case here some time ago of a man with a fractured patella treated by mobilization, pressure and massage, who was discharged from hospital on the 24th day. At the end of five weeks, when he was shown before the Surgical Section of the Academy of Medicine, function was perfect and the patella was apparently healed. In fracture cases passive mobilization was preferable to active. With these reservations, Doctor Woolsey considered Doctor McWilliams' paper very valuable.

DR. JOHN J. MOORHEAD (by invitation) referred also to a quotation, by Doctor McWilliams, from his article on synovitis of the knee, and wished he had a reprint with him so that he could add another page. He expressed his accord with those members of the Society who said that these patients should be selected. In certain types the convalescence could be shortened by immediate aspiration and mobilization, but the speaker was not in favor of aspirating every case of synovitis of the knee.

DR. JOHN A. HARTWELL said he understood Doctor McWilliams to say that coagulation in the synovial fluid might result in a foreign body, and he asked Doctor McWilliams if he would give his authority for believing that such coagulum could result in a foreign body, or "joint mouse."

DOCTOR MCWILLIAMS, in closing the discussion, explained that all he had wished to do in this paper had been to bring out the fact that the routine treatment of synovitis should be aspiration and mobilization. The patients with a large amount of fluid in the joints have very great pain, and the quickest way of relieving them and getting them well is to repeatedly aspirate. He did not think it should be laid down in the text-books that there are two methods of treatment, one of which is as good as the other. There is only one best way and that is aspiration combined with mobilization, and this should be the routine treatment of acute synovitis with fluid. The patient cannot get motion without aspiration because otherwise motion is too painful. Replying to Doctor Hartwell, he had no definite proof about the coagulum, but some of these cases treated with aspiration are so prolonged that it is presumable that this is due to the residuum of the fluid. Doctor McWilliams firmly believed that soon aspiration of fluid in a knee would be considered just as essential as aspiration of fluid in a chest.

## CORRESPONDENCE

### A POWER-DRIVEN TO-AND-FRO SAW

EDITOR ANNALS OF SURGERY:

Sir:

The foundation of modern bone surgery was laid with the advent of the X-ray. The X-ray has served to give us a definite knowledge of bone topography in both the normal and abnormal state.

The processes of bone regeneration are open to accurate observation and study. The belief in the bone regenerating power of the bone marrow, *per se*, has received a practically unanimous quietus. This conclusion has a forceful demonstration in the inability of the marrow to rehabilitate a bone pin placed in its substance. The bone has been removed and the X-ray shows new bone developing from the osteogenetic layer of the retained periosteum. Fractured bones have been separated only with the periosteum bridging the gap. Heavy deposits of callus following the course of the periosteum indicate the bone regenerating qualities of the periosteum. Severed bones show a reunion on their contacting surfaces. Here we must conclude that regeneration occurs through the functioning of the osteoblasts of the special network of the compact bone.

We have seen the interposition of fibrous or other alien tissue between these osteogenetic structures act as effective barriers to the formation of new bone and union.

An ever present recognition of these underlying facts is essential in all operative processes for bone repair. It is evident that perfect apposition of periosteum and compact bone is the aim and ideal of the operation, since it promises the quickest and best regeneration of the bone.

If there is secured a united and continuous vital periosteum, the prospects for bone regeneration are good. If there is positive contact of healthy compact bone we can expect union. Naturally the more completely these conditions have been met, the more prompt is the union.

Is it not likely that the delayed union extending over many months is due to lower vitality as much as it is to actual scant osteogenetic contact? If there is that fortunate condition that once the bone cells have effected a union, they continue to spread till the physiological demand for an ample union is accomplished.

To secure a prompt union, or in other words to gain an extensive contact of healthy compact bone and a united vital periosteum, our operations must meet these demands. Herein has been the major difficulty. Bone is not soft tissue that can be drawn by suture to perfect coaptation. Periosteum is not readily stripped and preserved. Sometimes scar tissue is preserved with the periosteum when it should be eliminated.

122~

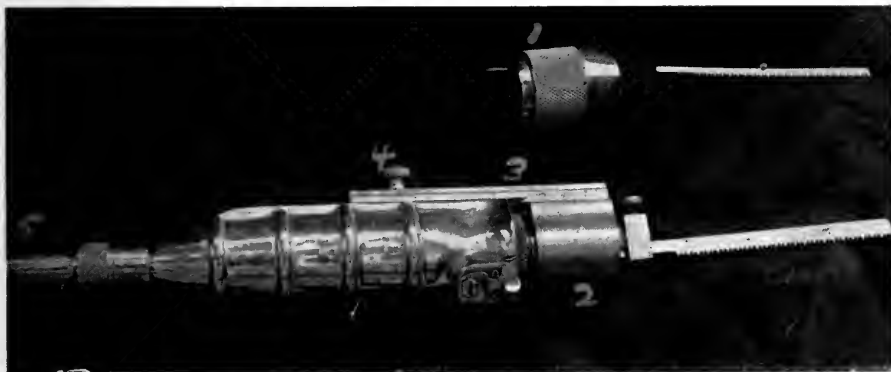


FIG. 1.—A to-and-fro power saw. Instrument can be boiled. 5 connects with the power. To change movement, unscrew 4, slide 3 off, unscrew 2 and attach chuck 1, making rotating holder.





To secure an extensive coaptation of compact bone the hand chisel, the burr, forceps, etc., are crude instruments at the best, since a slight irregularity can prevent a close coaptation of an extensive surface.

The introduction of a power-driven saw making smooth cuts was a real essential and most welcome in the development of bone surgery. Improving our instrumental facilities has been the object of intensive study on my part for some years. The bone equipment I have produced will saw the bone, drill, burr, tap threads, make bone pins, bone screws, etc., all without burning, with a delicate control and with perfect reliability.

A circular saw, however, has its limitations. It will cut through a compact layer, but will not make a smooth, unbroken cut of a bone shaft of appreciable thickness.

To fit the bone ends in a non-union or to cut deformed unions we have had to use the chisel. The need for a smooth accurately cutting implement has prompted me to devise the to-and-fro or linear saw shown in the illustration. (Fig. 1.) As with all instruments, power driven especially, it must be used rightly to get best results. The saw is long enough, strong enough, to cut the femur and naturally any smaller bone. It has a short to-and-fro movement to prevent penetration of the soft tissues. The short stroke is compensated by the rapidity of movement, though this is not sufficient to burn the bone.

The instrument can lie free in the hand running full speed. In cutting, the bone must be held rigidly to prevent losing any of the length of the short stroke of the saw. The instrument is practically indestructible. About the only requirement is to see that the tip of the saw does not catch in the cut in the bone.

The saw is adapted for amputations, for trimming true smooth ends in non-unions, for cutting deformed unions, for making false joints, etc. Where a false joint is desired it is possible to make a slight curve as the saw passes through the bone.

The device transforming the rotary to a to-and-fro movement is readily removed from the regular handle of the equipment. The regular chuck can be attached and we have the simple rotating handle for the various accessory rotating tools.

HARVEY C. MASLAND, M.D.,

*Philadelphia, Pa.*

## COMMENTS ON THE AIR OF SOME SURGICAL OPERATING ROOMS, AND UPON THE PRESERVATION OF THE BODY WARMTH OF PATIENTS

EDITOR ANNALS OF SURGERY:

Sir:

I wish to express my deep appreciation of a recent<sup>1</sup> communication by Mr. J. P. Rowlands, as to the questionable benefit to patient and operator accruing from working in stifling places. Personally, I should just as soon think of performing my morning physical exercise, as of operating, in the poisonous atmosphere of some of the trig parlors now grandiloquently styled

modern operating theatres. I have often wondered if the designers, much less the performers, in these lethal chambers ever ask themselves the question, is such an atmosphere conducive to the *bien être* of the unfortunate victim, who in all probability, is already saturated with toxins and who is necessarily being doped with an anæsthetic—both of which tend to render him a likely candidate for post-operative acidosis. Deprivation of a free supply of God's fresh air in such a moment of crucial cardiac extension is, in my humble opinion, an act worthy of "sentence" or "the certificate."

In order to obviate misunderstanding, I wish to emphasize that I am all for keeping the patient warm throughout operation—and for this purpose have had my operating tables fitted with suitable electric<sup>2</sup> installations—by which means the patients are kept beautifully warm with the result that shock and post-operative lung trouble are comparatively rare incidents. In parenthesis—the first operating table purchased (1897) by me for the British Hospital, Buenos Aires, contained a large open hot water tank—which, by the way, has now been converted into a commodious receptacle for "an electric resistance." The bodies, above and below operative field, are clothed in wool—and dry sterilized towels do the rest. While three calefaction installations heat the interior—a free supply of fresh air pours in continuously through the six windows (two, most efficient for ventilation, are long narrow ones level with ceiling); in summer time they are often all kept wide open, and in other seasons, the slightest sensation of stuffiness calls forth "open that window," *i.e.* the one which is likely to provide the air without any current or blast which might perturb the solar plexus through undue cooling of exposed intestines. It has been my habit since I commenced (1894) operating to do everything possible to make my body feel as light and airy during a hard morning's work as I wish it to be in the middle of a hard single at tennis or at all square on the 17th green.

As I always have my hair cut short and endeavor to keep my teeth clean and mouth shut,<sup>3</sup> I forego in the way of head gear the immaculate combination of a Turkish Madonna and a French Chef. Keeping a patient warm during operation is somewhat analogous to that of keeping warm in bed during winter—so far I do not know of anything, for this purpose feeling fit and fresh in the morning, equal to sleeping in a room with a large open window (not in a draught) with plenty of warm bed clothes (a thick football Jersey is a valuable item).

Possibly this conclusion may be due to some personal idiosyncrasy—if so, I should be gratified to hear the opinion of those who sleep in a room solely artificially ventilated, or in a room without any ventilation beyond what the crevices of a shut window afford? Or of those who cover the head, mouth and nose with the rest of "it" within the same sheets? The latter being particularly apropos to the context, as it possesses an obvious analogy to the condition of the patient under anæsthesia in a super-heated theatre, struggling for life—half smothered in exhalation and gas.

There is another matter<sup>5</sup> in which Mr. Rowlands and I are in complete accord—but which I hesitate to recommend to operators who are accustomed to work under such pressure, *i.e.* to practise operating to the clock—for fear that the shock of such an academic outrage (!) much less the extra strain it might entail in an atmosphere “which<sup>4</sup> in half an hour causes a person, in normal state of health and strength, to burst into a cold sweat or to acquire a splitting headache,” might induce a cerebral disaster.

*The use of gloves in delicate visceral operations.* While I am a confirmed believer in the regular use of rubber gloves by my assistants and dressers—and personally in septic cases—I should as soon think before entering the drawing-room after a postprandial wash of the hands of trusting the adjustment of my buttons to gloved fingers as to confide separation of intestinal adhesions obscured *e.g.* in the depth of pelvis to the gloved fingers of “the up to date” super-surgeon.

I have been assured by physiologists who have made a profound study of organic tactile sense that even with the interposition of the most delicate foreign membrane between living parts the acuity of perception is greatly diminished—and stimulation to cellular response appreciably inhibited.

JOHN O'CONOR, M.D.,  
*Buenos Aires, Argentina.*

## REFERENCES

<sup>1</sup> Lancet, August 1, 1922.

<sup>2</sup> British Medical Journal, February 4, 1922. Author.

<sup>3</sup> Operating to the Clock, British Medical Journal, December 21, 1918. Author.

<sup>4</sup> Lancet, August 8, 1922.

<sup>5</sup> Time in Surgery, Clinical Journal, November 17, 1920.

### PRIORITY IN THE EXTIRPATION OF THE GASSERIAN GANGLION

EDITOR ANNALS OF SURGERY:

Sir:

In a paper under the caption, “Surgery of the Trigeminal Tract,” published in the Journal of the A. M. A. of October 29 last year, Doctor Frazier of Philadelphia says: “It is within the memory of most of us when J. Irving Mears of Philadelphia in 1881, first proposed the removal of the Gasserian ganglion and when Hartley of New York in 1891 first performed this operation, etc.”

The learned doctor is absolutely mistaken. The operation must have been proposed long before the day of Doctor Mears. It was performed in the United States as far back as 1869 by Dr. H. E. Foote, Professor of Anatomy in Miami Medical College of Cincinnati, and one of the visiting surgeons to the Cincinnati Hospital. The patient was a woman by the name of Ellen Carney, a sufferer for many years from neuralgia of the nerves of the upper and lower maxillary regions. In the year named I was one of the resident physicians of the hospital referred to, and at the time in charge of the service of Doctor Foote.

The case presents several interesting points. The operation was done on a Saturday morning, was begun about twelve noon, and finished at 2 P.M. It was attended by Doctor Dawson (a well known surgeon), who assisted Doctor Foote, and a number of other surgeons and physicians connected with the hospital. As the interne in charge of the service I administered the anæsthetic, chloroform, in the simple fashion then in vogue.

There was no thought of asepsis or antisepsis (no sterilizing of instruments, no preliminary scrubbing and disinfecting of the hands of the surgeons, etc.). All that was done was to pour a little carbolic acid into the warm water in the tray in which the instruments lay.

The cavity left in the superior maxillary was filled with small pieces of sponge cut from a larger sponge which had lain in the carbolized water in the tray, and the wound was closed with several layers of gauze bandage wound around the head. At the close of the operation I was instructed by Doctor Foote to remove the sponges on the following morning (he did not visit the hospital on Sunday).

On my night round I found the patient in the condition she was in when brought from the operating room, apathetic, listless, cold, pulse feeble, hardly perceptible. The next morning I found her still under the influence of the shock and did not remove the sponges. About 1 P.M. I was hurriedly summoned to the ward; the patient was sinking rapidly I was told. I hastened to the bedside and found the patient going fast; her hands cold and clammy, her feet like ice, body cold, eyes with a glassy stare and almost breaking. I realized that no time was to be lost here if the patient was to be saved. We always had hot milk in the ward kitchenette, so I bade the nurse bring it in. She brought an oyster-soup-bowl about three quarters full. I added to this about three ounces of whiskey, opened the patient's mouth and managed to let the lacteal fluid down her œsophagus. It had some effect—seemed to bring her to, somewhat. Ten minutes later I repeated the dose. Fifteen minutes after this I gave a third dose and in half an hour after this a fourth one. The patient was very much better, but she was still very weak, and there was a tendency to relapse into the state of collapse. To make a long story short, till 1 A.M., during all of which time I stayed with the patient, I gave her ten such doses. At that hour, feeling satisfied that the crisis was over and the patient on the road to health, I retired to rest. The next morning (Monday), as I made my round, I found the patient quite bright and fairly vigorous, and when the surgeon made his visit he removed the sponges and as he inspected them he remarked, "Not a sign of pus." The woman made a quick and uneventful recovery. I saw her several years later and she still complained of pain along the inferior maxillary, though she was much better, free from the horrible sufferings she had endured before.

I am certain that the milk and whiskey filled her blood-vessels with the warm nutrient and stimulating fluid, and thus stirred up and gave

strength to the lagging heart and saved the patient. Not all the stimulants of the Pharmacopœia could have done it. Furthermore there can be no doubt but that it was the whiskey so freely administered that saved the patient from infection, as it destroyed all septic elements both in the blood and in the wound. That this must be so is clearly demonstrated by the fact that in those days, which were the days of pus lore, every operation was followed by suppuration, and that abdominal operations were not attempted at all, at least in this hospital, because of the great fatality that attended them.

The history of this case can be found in the records of the hospital for the year named.

HENRY ILLOWAY, M.D.,  
*New York City.*

### THE ESSENTIAL FEATURE OF THE ABDUCTION TREATMENT FOR FRACTURE OF THE NECK OF THE FEMUR

EDITOR ANNALS OF SURGERY:

Sir:

I note that Doctor Wilensky in his interesting paper on immediate operation for fracture of the neck of the femur refers to the "plaster treatment" and to its various modifications by Whitman, Mixter and Moore. What he really has in mind, I infer, is the abduction treatment and its modifications. He defines the treatment, however, as the "immobilization of the fracture in plaster," and it is evident that the outward and visible sign of the plaster spica has made more impression on him than the inward and spiritual grace of which it is merely the manifestation. As he shares this conception with many others, I shall take this opportunity to point out the vital distinction between internal, or natural, splinting and that dependent upon external appliances.

The abduction treatment differs from all others in that it utilizes the mechanics of the hip joint to correct resistant deformity by natural leverage, and to fix displaced fragments by capsular tension and bony resistance. To assure the internal splinting the limb must be fixed in complete abduction and extension, and for this subsidiary purpose a plaster spica is used, not because it is an essential part of the treatment, but because it is the most available, and when properly applied the most comfortable appliance at command.

The abduction method is the exponent of radical reform simply because it applies the surgical principles that govern the treatment of all other fractures. It was introduced to the profession twenty years ago, at a time when it was taught that the intracapsular fracture could not unite, that the deformity of the so-called impaction should not be corrected, and that the treatment of the fracture as a fracture was in most instances dangerous and futile, therefore, that "restoration of form and function was rarely to be attempted or even sought"; when treatment in three of the leading hospitals in New York was characterized by an investigator as worthless, and when, according to the report of the British Committee, in but 23 per cent. of the cases of fracture of

the neck of the femur actually treated could the results be classed as satisfactory.

The experience of the past twenty years has demonstrated conclusively that in the great majority of cases, fracture of the neck of the femur, in competent hands, may be treated like other fractures, and that, relatively speaking, the results compare favorably with those of other fractures in patients of the same class.

Doctor Wilensky thinks that, of fractures within the capsule "when treated badly or inefficiently" not more than 10 or 15 per cent. will unite, and since the fracture is inefficiently treated by the average worker, this percentage may be accepted as representative.

He concludes, therefore, that these fractures may be treated with advantage by primary bone pegging, the inference being that bone pegging will always be performed by experts, and that it will always be successful.

It seems to me, that, if this percentage actually represents the results obtained by the average worker, that the average worker should no longer treat fracture of the neck of the femur. Furthermore, that since the abduction method is the only means by which the fragments of the intracapsular fracture may be brought end to end and forced into resistant contact, the surgeon who does not avail himself of this means to provide the opportunity for repair should be held responsible for the result, not because opportunity will always assure success, but because the lack of opportunity for which he is responsible makes failure inevitable.

ROYAL WHITMAN, M.D.,  
New York City.

### TRAUMATIC PANCREATITIS

EDITOR ANNALS OF SURGERY:

Sir:

In the October, 1922, number of ANNALS OF SURGERY in an article on "Traumatic Pancreatitis" by myself, I quoted from an article by Dr. Stuart in *North West Medicine*. This article was written by Dr. C. Stuart Menzies, of Portland, Oregon, and through an error made by *North West Medicine*, the latter part of his name was omitted.

Will you please make correction, and give the credit for the article quoted, to its author, Dr. C. Stuart Menzies?

EARLE DRENNEN, M.D.,  
Birmingham, Ala.

#### To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

**ANNALS of SURGERY**  
227-231 S. 6th Street  
Philadelphia, Penna.

# ANNALS *of* SURGERY

VOL. LXXVII

FEBRUARY, 1923

No. 2

## THE REGENERATION OF THE MENINGES \*

THE DURA MATER

BY WILLIAM Y. SAYAD, M.D.

AND

SAMUEL C. HARVEY, M.D.

OF NEW HAVEN, CONN.

FROM THE SECTION OF SURGERY, SCHOOL OF MEDICINE, YALE UNIVERSITY

It has been a general assumption that it is necessary to fill a defect in the dura mater with something resembling the normal membrane which might serve as a substitute for the absent dura. There are many references in the literature to such substitutions and many artificial membranes have been proposed.

Abbe,<sup>1</sup> in 1895, referred to a patient of Beach's in whom gold foil had been employed to cover the raw area left after the separation of subdural adhesions. He himself in two similar cases had employed rubber tissue. Such attempts were, however, sporadic up to the recent war, at which time this subject became of considerable interest because of the large number of patients suffering from post-traumatic epilepsy. Several substitutes for the normal dura were suggested either to prevent the reformation of adhesions broken up at secondary operation or such formation at the time of the operation on the original wound. Brun<sup>2</sup> discussed this subject in relation to four cases of cortical epilepsy and found no satisfactory solution of the difficulty. Jeger,<sup>3</sup> in 1916, employed transplants of fascia to close such defects. von Eiselsberg,<sup>4</sup> in a general report before the German Surgical Congress of the same year, discussed post-traumatic epilepsy and particularly with reference to the prevention of adhesions between the brain and its envelopes. He referred to the use of implants of fat, of omentum, and of celluloid plates. Neuhof,<sup>5</sup> in 1920, in a discussion of fresh injuries of the brain, reported a number of instances where fascial transplants had been used by him for the closure of dural defects, and Kerr<sup>6</sup> the same year advocated the inversion of cranial bone transplants, thus bringing the periosteum next to the cortex in order that, in a certain sense, it might replace the absent dura.

All substances, even autogenous grafts, may be fairly assumed to be but poor substitutes for the normal dura, and it is indeed doubtful if they act in any other manner than as a scaffolding for the ingrowth of new tissue. Denk, as quoted by Neuhof,<sup>5</sup> examined such a fascial transplant eleven months after the operation and found it transformed largely into dense fibrous tissue, apparently as the result of gradual disintegration with simultaneous

\* The substance of this paper was submitted by William Y. Sayad as a thesis for the degree of Doctor of Medicine, Yale University.

tissue replacement. He stated that it is evident that the fate of the transplanted fascia is unknown and that the possibilities are in favor of its ultimate death.

That there is a certain appreciation of this probability is evidenced by current civil practice where one rarely sees the neurological surgeon attempt to

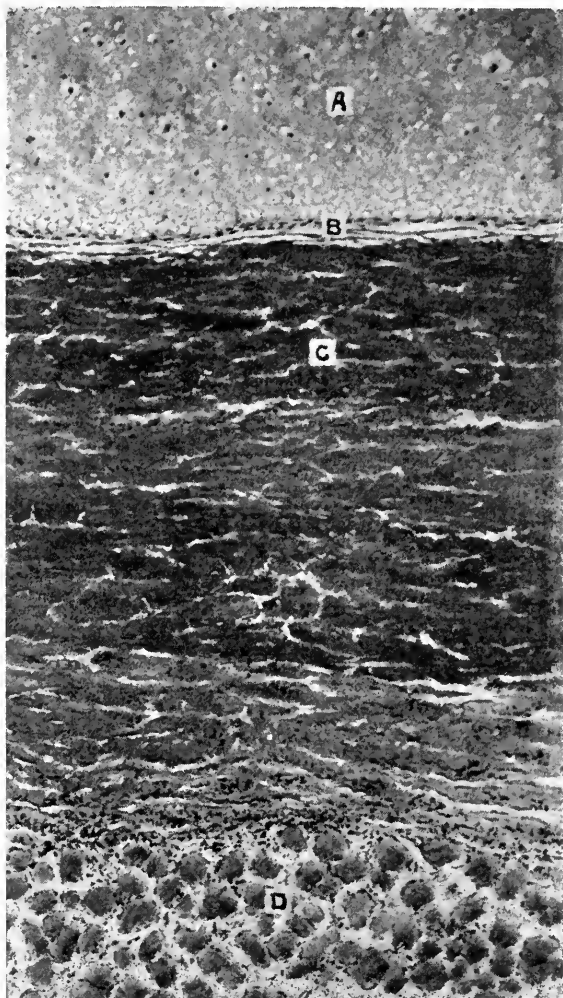


FIG. 1.—Protocol I, sixty hours. A—Normal brain. B—Normal pia and arachnoid. C—Blood clot. D—Temporal muscle.

reconstruct the dura with such substances. There has grown up a feeling, based on clinical experience, that the dura takes good care of its own defects and that the introduction of foreign bodies only increases the adhesions. Trotter<sup>7</sup> goes so far as to say that of all the membranes of the body the dura is the one which is most certainly and rapidly reformed after partial excision and as he has observed at secondary operation, such defects invariably and completely heal in a few weeks, and are scarcely to be distinguished from the normal. The regenerated dura possesses the three characteristics of the normal dura; that is, the glistening inner surface, the extreme density, and the differentiation from the overlying structures.

Reasoning from analogy one need not be surprised at the statements of Trotter. The peritoneum closes any defect in its surface rapidly and many times without adhesions. Experimentally Vogel<sup>8</sup> has observed closely its healing and has found, that, provided a single area is destroyed in such a manner that raw surfaces do not come in contact, the regeneration of the peritoneum is rapid and its normal continuity soon established. The canalization of thrombi by endothelial lined spaces and the efforts at regeneration in chronic obliter-



ative pericarditis also would suggest that the endothelial or mesothelial lined membranes of the nervous system might well make similar efforts at repair.

That such healing may take place without the formation of adhesions is not so apparent and, indeed, judging from clinical experience, adhesions are most frequent sequelæ. Marchand<sup>9</sup> goes so far as to say that the formation of adhesions is a necessary concomitant of the healing of the dura.

In view of the somewhat divergent opinions, it seemed worth while to subject the healing of the dura to experimental investigation. The healthy adult dog was chosen as the subject and the following procedure carried out. Under ether anæsthetization the temporal muscle was reflected downward in such a manner as to expose adequately the parietal bone. A button of large size was removed with the crown tre-

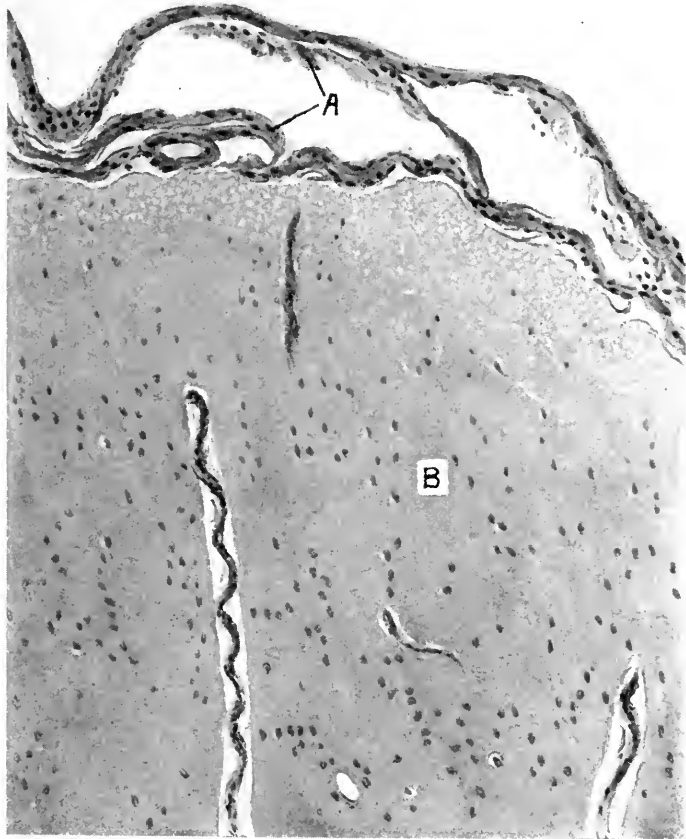


FIG. 2.—Protocol I, sixty hours. A—Pia and arachnoid. B—Brain, showing the absence of trauma and consequent cellular reaction.

phine and the dura beneath carefully excised, particular care being taken not to injure the arachnoid and pia. The area removed was accurately determined by Douglas'<sup>10</sup> method for the measurement of wounds. The dura and bone defect were allowed to fill in with blood clot, the temporal muscle carefully sutured in place with interrupted silk and the remainder of the wound closed in layers. After the time interval determined upon, the animal was sacrificed and the brain fixed *in situ* by the injection of formalin through the carotid

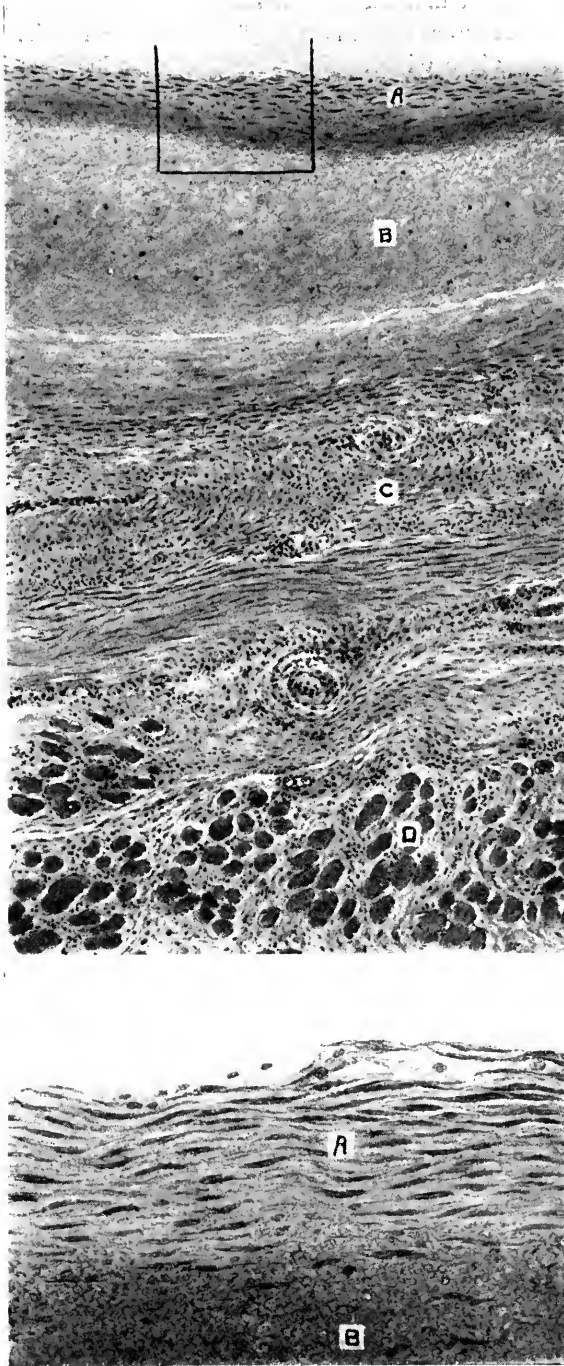


FIG. 3.—Protocol III, fourteen days. A—Cells lining new dura. B—Remains of blood clot. C—Connective tissue layer of new dura. D—Temporal muscle.

arteries. The tissues surrounding the wound, including the adjacent brain, were then removed *en bloc* and studied with particular reference to the presence of adhesions, the appearance of the arachnoid and pia, and the character of the newly formed structure occupying the dural defect. Sections for microscopic studies were made from suitable blocks and stained with hæmatoxylin and eosin. The protocols of these experiments are as follows:

*Protocol I:—Dog 4:—*  
Operated upon January 23, 1921 and 2.8 sq. cm. of dura removed. The animal died in 60 hours from causes not related to the operative procedure, and was autopsied two hours later.

*Gross Examination.*—  
There was no exudate or other signs of infection of the wound. The brain beneath the dural defect was found to be closely adherent to the overlying blood clot which was about 2 mm. in thickness. The latter was likewise adherent to the overlying temporal muscle.

*Microscopic Examination.*—The cortex of the brain immediately adjacent to the dural defect was quite normal, in particular there was no evidence of hemorrhage or inflamma-

tory reaction. The pia and arachnoid were clear of any signs of injury, but immediately and intimately related to the arachnoid was the blood clot as described above. It had the appearance of any blood clot with beginning organization. There was no invasion of phagocytes, wandering, or polyblastic cells from the arachnoid surface, but from the side of the temporal muscle many mononuclear cells resembling those seen in the blood stream were passing inward toward the deeper portion of the clot. Accompanying these were a few polymorphonuclear neutrophils and an occasional lone cell with faint staining single nucleus and a large amount of cytoplasm. Phagocytosis had not yet taken place to any great degree. The cells were distributed in much greater number at the edge of the muscle and grew proportionately less the closer one came to the arachnoid surface. The muscle itself showed a considerable amount of œdema with fibrin and red blood cells along the line of incision. The picture was that of an early resolution of a blood clot in which the cellular infiltration was proceeding from the muscle surface and not from the arachnoid which itself seemed quite normal.

*Protocol II:*—Dog No. 12:—Operated upon March 8, 1921, and 3.45 sq. cm. of dura removed. The animal was sacrificed seven days later and autopsied within four hours.

*Gross Examination.*—The wound was thoroughly and cleanly healed. The brain was not adherent at the site of the operation and during preparation dropped away from the new dura. Over the excised area were seen remnants of thin blood clot covered with a smooth glossy surface directly continuous with the adjacent dura. This new tissue was thin and through it the edges of the trephined bone could be seen.

*Microscopic Examination.*—The brain showed no areas of hemorrhage and no cellular infiltration. The pia and arachnoid were quite normal in appearance throughout, and there was no evidence of adhesions. The blood clot had in a large degree undergone organization. There was still remaining some of the hemorrhage which was being rapidly taken up by phagocytic cells. Scattered throughout the section and particularly along the edge of the temporal muscle were large macrophages filled with broken-down blood pigment. At this latter point there were also a few minute pieces of bone, one or two of which were surrounded by giant cells. These were undoubtedly broken off at the time of the operation and included in the blood clot. Between the temporal muscle and the free surface of the section the tissue was made up in considerable part of fibroblasts, those nearer the muscle already having laid down numerous fibrils. There were many newly formed blood-vessels, which became less frequent as the cerebral surface was approached. All these new cells were laid with a remarkable uniformity in a plan parallel to this surface. As one approached the meningeal side of the section one encountered with greater frequency cells with large, elongated, faintly stained nuclei and a considerable amount of cytoplasm, many of which showed no tendency to fibril formation, thus suggesting their origin as from the wandering or polyblastic cell. At the surface itself there was a definite lining membrane or plate of cells which was certainly of an endothelial type. This seemed to form a perfectly smooth uniform surface which was quite similar to that of the endothelium of the normal dura. There was no evidence of adhesion formation and the approximation in appearance to the normal dura was quite remarkable. Throughout the section there were present, of course, all the varying types of polyblasts that one sees in granulation tissue anywhere.

*Protocol III:*—Dog No. 13:—Operated upon March 14, 1921, and 3.66 sq. cm. of dura excised. The animal was sacrificed fourteen days later and the carotids injected with formalin immediately.

*Gross Examination.*—The brain or its envelopes were nowhere adherent and presented normal surfaces even adjacent to the area of the excised dura. Over this area of excision there was present on the dural side a shiny, smooth, thin layer of tissue perfectly continuous with the edges of the attached dura. Beneath this could be seen shining through, small areas of old blood clot. This new tissue was of course adherent to the overlying temporal muscle.

*Microscopic Examination.*—The brain seemed normal in every respect. There was no sign of injury or inflammatory reaction. The pia and arachnoid could not be distinguished from those of the normal brain. In particular, there was nothing to indicate the presence of adhesions. Overlying the temporal muscle in the area of the newly generated tissue there seemed to be adjacent to the muscle a well developed young connective tissue overgrowth. Bundles of cells ran in various directions and most of them seemed to be particularly oriented parallel to the free surface while there were no bundles seen running perpendicular to it. At one corner of the section the old endosteal portion of the dura was turned back upon itself and became directly continuous with the newly formed fibrous tissue.

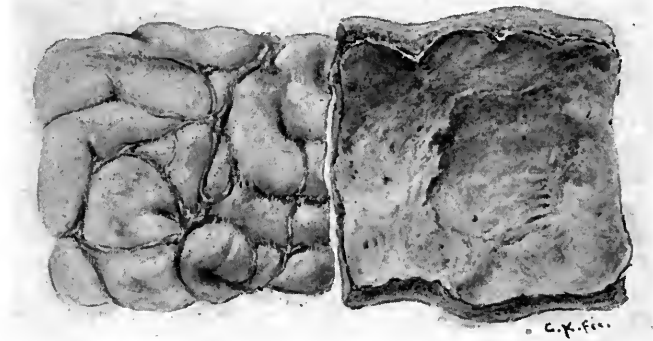


FIG. 4.—Protocol VI, twenty-eight days. Gross appearance of brain and newly formed dura.

Over a considerable portion of the section there was a layer of old blood clot still undergoing the process of organization. There would seem to have been in this case a much larger blood clot formed than in the previous one and consequently the resolution in some places was not as complete, even though the dog lived a week longer. However, on the free surface throughout the section and directly continuous with the endothelial lining of the dura proper was a plate-like layer of endothelial cells, the only difference from the normal dura being that in this region it was several cells deep. This layer was continuous into the contiguous portion of the blood clot itself, and there it gradually thinned out so that these cells became isolated. As in the previous section there were cells with rather faintly staining nuclei but large and elongated, and with a considerable amount of cytoplasm which did not yet show fibril formation. In the deeper layers, however, it would have been difficult to distinguish these cells from young fibroblasts, but in the superficial layers they had the same appearance as those found over the normal dura. Otherwise the tissue was not remarkable, showing the same cellular constituents and blood-vessel growth that would be seen in the organization of a clot at this stage elsewhere.

*Protocol IV:*—Dog No. 11:—Operated upon March 5, 1921, 3.46 sq. cm. dura being excised and immediately fixed with formalin. The animal was sacrificed fifteen days later.

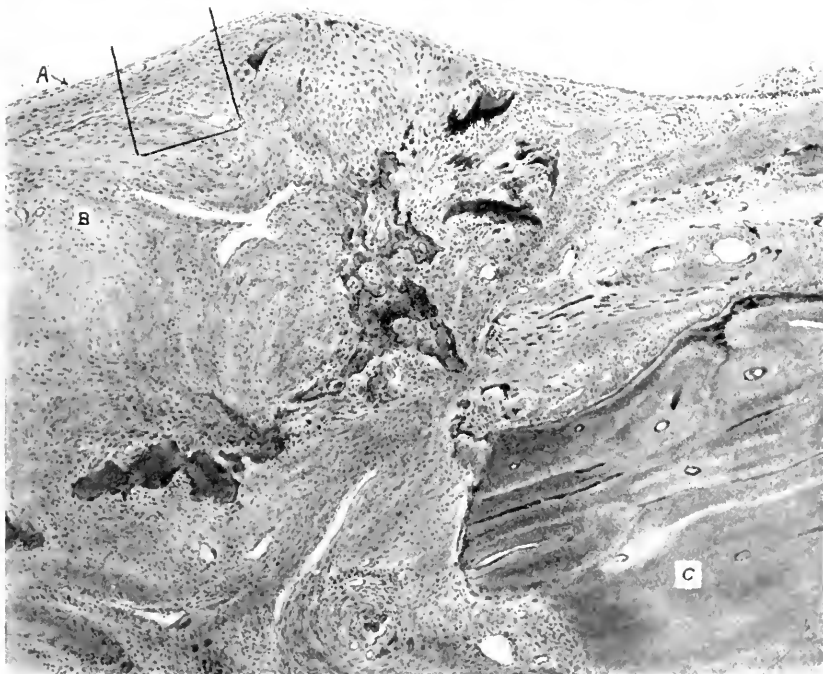
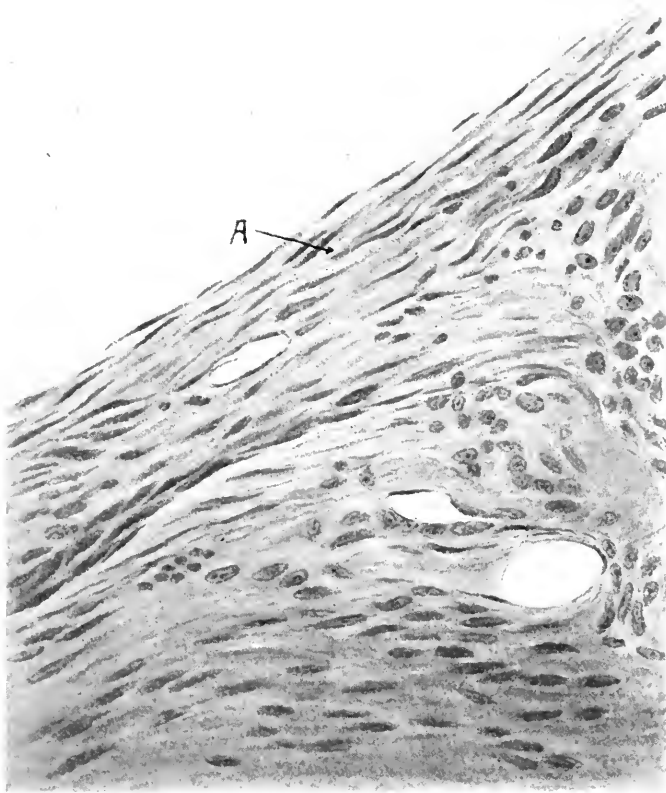


FIG. 5.—Protocol VI, twenty-eight days. A—Newly formed lining of dura. B—Connective tissue of new dura. C—Bone of skull at edge of trephine opening.

*Gross Examination.*—The brain was not adherent to the overlying dura and shelled out spontaneously with no gross evidence of adhesions. The pia and arachnoid layers appeared normal. Over the area of the excised dura there was present tissue of the same glistening appearance as the surrounding dura. It was somewhat more whitish and appeared also thicker but otherwise did not differ from it markedly.

*Microscopic Examination.*—The brain appeared perfectly normal in every respect. Neither it nor the pia and arachnoid showed any signs of hemorrhage or of inflammatory reaction. There were no adhesions. The newly formed membrane was somewhat thinner than the one in the previous protocol but made up of more condensed tissue. There was evidently a smaller blood clot and an earlier resolution. On the temporal side adjacent to the excised bone there was a considerable area of cellular infiltration with phagocytic and giant cells grouped around a greater number of loose fragments. Between this, however, and the cerebral surface and directly continuous with the endosteal layer of the dura there was a solid layer of young connective tissue with many new blood-vessels

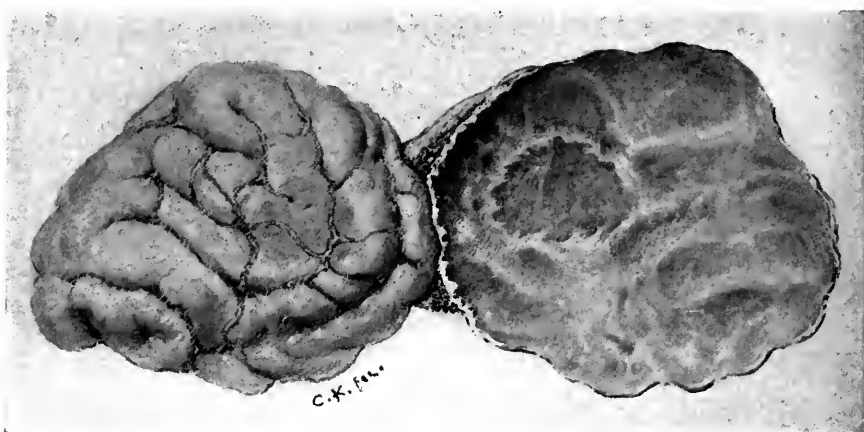


FIG. 6.—Protocol VII, thirty-five days. Gross appearance showing repair of dural defect.

running through it. There was scarcely any evidence of the old hemorrhage except the few large phagocytic cells filled with blood pigment. On the surface and directly continuous with the endothelial layer of the old dura was a plate-like layer of endothelial cells two or three deep. These could not be distinguished from those of the normal dura and were scarcely different from the adjacent connective tissue. In this section there seemed to have occurred a higher degree of differentiation, and the result was a membrane approximating very closely that of the normal dura.

*Protocol V:*—Dog No. 10:—Operated upon March 2, 1921, and 4.24 sq. cm. of dura excised. The animal was sacrificed 22 days later and immediately injected.

*Gross Examination.*—The brain shelled out of its own accord, and there were no adhesions present. The pia and arachnoid were perfectly normal in appearance. The defect in the dura was completely filled with newly formed tissue to which the temporal muscle was adherent. The new tissue had much the same appearance as the surrounding dura, being very smooth, and glistening in appearance, but somewhat more white and opaque.

*Microscopic Examination.*—The brain and its membranes immediately adjacent were entirely normal. There was no evidence of any reaction to injury and no

adhesions were present. In the temporal muscle and at the edge of the trephined bone there were many bone fragments surrounded by foreign body reaction on the part of the tissue. Otherwise the appearance was much the same as seen in the last section except that the newly formed tissue was still more condensed and contained, particularly on its free surface, a great number of vessels, many of which were of large size and had extremely thin walls. The connective tissue appeared distinctly older than in previous experiments but was still in large part arranged tangentially to the surface. There was a layer of endothelial cells, two or three deep, quite sharply differentiated from the underlying fibroblastic tissue, and forming the surface of the membrane. The appearance was that of the ordinary healed scar of the same age, aside from the endothelial lining which approximated very closely that of the normal dura.

*Protocol VI:—*Dog No. 6:—Operated upon February 2, 1921, and 6.13 sq. cm. of dura removed. The wound was superficially infected but with careful treatment was induced to heal in about 3 weeks. The infection at no time extended

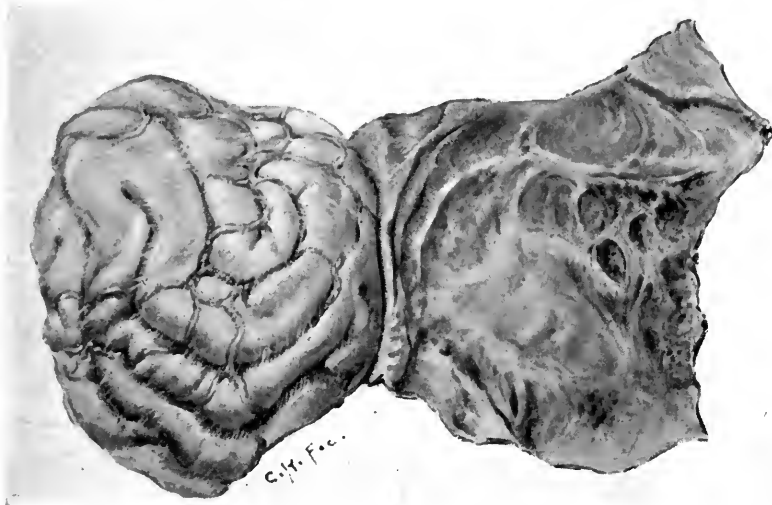


FIG. 7.—Protocol VIII, forty-three days. Gross appearance showing repair of dural defect.

beyond the superficial layers. The dog was killed 28 days after the operation and the head immediately injected.

*Gross Examination.*—On isolating the specimen the brain shelled out spontaneously. The surface was quite normal in appearance and the arachnoid was smooth and showed no evidence of adhesions. The dura had completely regenerated and was to be distinguished from the surrounding normal dura only by a somewhat thicker appearance. The surface was smooth and glistening and there were no adhesions present.

*Microscopic Examination.*—The brain showed no abnormality. The pia and arachnoid gave no evidence of previous injury. There was no inflammatory reaction or old hemorrhage and no adhesions were present. In this section the connective tissue had quite an adult appearance. It was arranged in whorls but in greater part tangential to the free surface. The cellular reaction to injury had largely subsided and there was present little else but fibroblastic tissue. The free surface was directly continuous with that of the normal dura and the endothelial layer, somewhat thinner than previously seen, was only one or two cells deep in

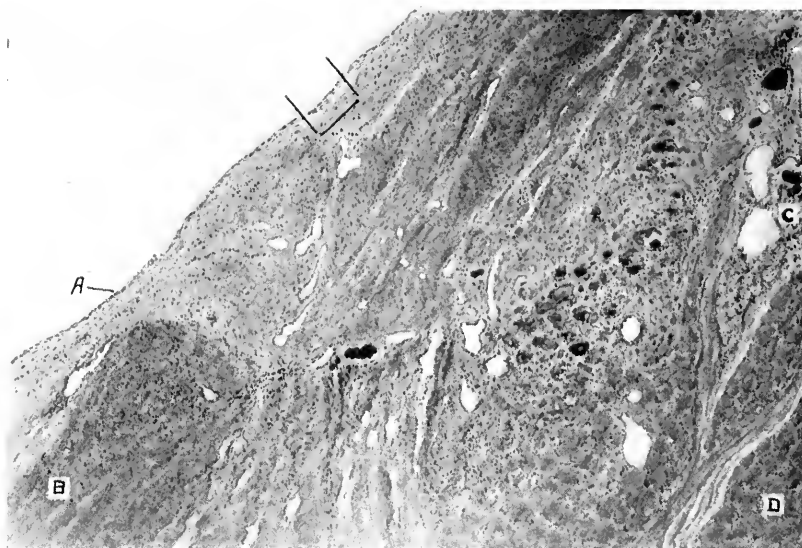


FIG. 8.—Protocol VIII, forty-three days. A—Newly formed endothelial lining of dura. B—Newly formed connective tissue layer of dura.



places and easily torn off by the sectioning of the tissue. It did not differ in any respect from that of the normal dura. There were beneath it in several places large newly formed blood spaces so that the new dura was very distinctly more vascular than the old. The process of healing seemed to be practically completed.

*Protocol VII:*—Dog No. 5:—Operated upon January 31, 1921, and 4.38 sq. cm. of dura excised. He was killed thirty-five days later and the head immediately fixed.

*Gross Examination.*—In the case of this specimen the brain shelled out spontaneously with no evidence of adhesions. Grossly it and its covering meninges appeared normal. The dura itself had completely regenerated, only appearing somewhat more opaque than the dura elsewhere and perhaps somewhat more vascular. The surface was quite smooth and glistening and showed no evidence of adhesions.

*Microscopic Examination.*—The appearance was not essentially different from that in the previous section. The amount of connective tissue seemed to be somewhat less and it was in large part adult connective tissue, immediately and intimately adjacent to the overlying muscle. There were many blood spaces and the process of regeneration was practically complete. Over the free surface there was a distinct plate-layer of endothelial cells two or three deep and definitely differentiated from adjacent connective tissue. Aside from the lack of regularity in the laying down of the connective tissue the new membrane did not differ essentially from the dura elsewhere.

*Protocol VIII:*—Dog No. 3:—Operated upon January 5, 1921, and 3.57 sq. cm. of dura removed. The dog was killed 43 days later and the head immediately injected with 20 per cent. formalin.

*Gross Examination.*—The brain shelled out spontaneously and with no adhesions. The appearance of the overlying meninges did not differ from the normal. Over the area of absent bone the dura was found scarcely to be differentiated from that elsewhere, it having the same glossy appearance and texture as the ordinary dura. It was intimately adherent to the temporal muscle.

*Microscopic Examination.*—The brain, pia and arachnoid were perfectly normal. The newly formed dura had much the appearance of the normal dura. It was immediately continuous with the temporal muscle on its outer surface and in one or two places there were present giant cells undoubtedly induced by some small bone fragments. The connective tissue layer was quite condensed and had every appearance of being adult connective tissue. There were a few blood spaces but the tissue as a whole was not nearly as vascular as that seen in the previous section. It was covered by a layer of endothelium only one or two cells deep and so fragile that it was in many places torn loose from the section, and corresponded in appearance to the endothelial lining of the normal dura.

*Discussion.*—From the findings as given in detail in the above protocols, one may gather the process of regeneration of the dura to be as follows:

The operative defect is filled at once by blood clot which on its inner face is lightly adherent to the arachnoid and on its outer intimately adherent to the exposed temporal muscle. The process of organization of the clot commences at once and takes place much in the same manner as it would elsewhere in the body. There is an immediate invasion of phagocytes, followed almost at once by wandering and polyblastic cells and then in time by fibroblasts. These all appear to come in large part from the overlying temporal muscle and to be evenly distributed throughout the clot. Those reaching

the inner surface adjacent to the arachnoid membrane become arranged in a plane tangential to that surface, and at sixty hours there is a distinct skeletal arrangement of the cells corresponding to the future architecture of the dura. In something less than a week certain of these cells are arranging themselves along the inner face of the blood clot in contact with the arachnoid, so that one begins to see a limiting membrane resembling the endothelial lining of the normal dura.

Whether these cells are derived from wandering cells, from polyblasts, or from fibroblasts is a matter that can only be determined by a long and detailed study of the special staining reactions. MacCallum<sup>11</sup> described the transition of young connective tissue cells into endothelial-like cells lining an infected space in the muscles of the neck of a dog and referred to the manner in which connective tissue lining any cavity, such as a newly formed bursa, may form a lining membrane. He was skeptical, however, as to this membrane ever becoming true epithelium. Aschoff<sup>12</sup> was likewise doubtful as to the occurrence of such a metaplasia. It is highly probable, however, from these experiments, that the endothelial or endothelial-like lining seen at this early period is derived from cells coming from the muscle side of the clot and not by the ingrowth of endothelium from the cut edge of the dura.

This surface is then complete in about a week and at this time the clot loses its fibrinous adhesions to the arachnoid. From this time on the process is largely one of growth and condensation of connective tissue behind the lining cells. These bundles of fibroblasts are laid down in a plane tangential to the arachnoid and the newly formed endothelial layer.

It is apparent that this healing takes place without the formation of adhesions and a study of the process detailed above explains this. The cells invading the blood clot do not come from the arachnoid, because as there is no injury to that membrane it is impervious to cells, certainly in any appreciable number. Rather they traverse the clot, and on reaching its inner surface come to the normal arachnoid against which they flatten themselves, thus forming the new endothelial lining of the dura. The fibroblasts are in a similar circumstance and consequently there is no growth of these into the arachnoid, which is essential to the formation of an adhesion. It is apparent that the injury of the endothelium of the arachnoid, either mechanically or in any other manner, would allow such penetration and bridging of the organizing cells and consequently lead to adhesions.

The clinical application of this problem is apparent. If the endothelial covering of the arachnoid is kept intact the dura will regenerate and fill its own defect, and that, moreover, without adhesions. If necessity or carelessness leads to the destruction of the endothelial lining of the arachnoid, then the dura will regenerate, but with its connective tissue largely adherent to the adjacent layer of the arachnoid and pia and with many adhesions.

*Summary.*—Defects in the dura of the dog operatively induced, without injury to the adjacent arachnoid, heal rapidly in from one to two weeks and without the formation of adhesions.

## REGENERATION OF MENINGES

### REFERENCES

- <sup>1</sup> Abbe, Robert: The Use of Rubber Tissue for Meningeal Adhesions. Tr. Am. Surg. A. Phila., 1895, vol. xiii, p. 490.
- <sup>2</sup> Bruns, L.: Ueber die Indikationen zu den Therapischen Speziell den Chirurgischen Massnahmen bei den Kriegs ferletzungen des Nerven Systems. Berl. Klin. Wochenschr., 1915, vol. lii, p. 989.
- <sup>3</sup> Jeger, E.: Ueber primare Fascienplastik bei Schussferletzungen der dura. Beit. z. klin. Chir., 1915, vol. xvii, p. 418.
- <sup>4</sup> von Eiselsberg: Krieg clinisch Hefte, Tübingen, 1916, vol. v, p. 68.
- <sup>5</sup> Neuhof, H.: The Treatment of Cranio-Cerebral Wounds and its Results. Am. Surg., 1920, vol. lxxii, p. 556.
- <sup>6</sup> Kerr, H. H.: Late Treatment of Gunshot Wounds of the Head. S. G. O., 1920, vol. xxx, p. 550.
- <sup>7</sup> Trotter: The Physiology of Pain. Medical Science Abstracts and Reviews, 1921, vol. iv, p. 48.
- <sup>8</sup> Vogel: Ueber Entstehung, Verhütung und Bebandlung von Bauchfellverwachsungen. Munchen. Med. Wochenschr., 1922, vol. lxix, p. 638.
- <sup>9</sup> Marchand, F.: Der Process der Wundheilung, 1901, p. 348.
- <sup>10</sup> Douglas, B.: A Gravimetric Method for Determining the Area of Superficial Wounds. An. Surg., 1921, vol. lxxiii, p. 673.
- <sup>11</sup> MacCallum, W. G.: A Text-book of Pathology, 2nd Edit. p. 200.
- <sup>12</sup> Aschoff: Pathologische Anatomie, 2nd Edit. vol. i, p. 566.

## CHRONIC EMPYEMA

ITS ETIOLOGY, PATHOLOGY, DIAGNOSIS, COMPLICATIONS, TREATMENT  
AND FINAL RESULTS

By CARL EGGERS, M.D.

OF NEW YORK

THERE is probably no suppurative inflammation of any part of the body, except that of bone, which leads to chronicity as frequently as inflammation of the pleura. The reason for this is that in addition to the element of infection, there are mechanical factors concerned. These factors are negative air-pressure within the closed thorax, mobility of the mediastinum and diaphragm, a rigid thoracic wall, and the development of an open pneumothorax, when the chest is opened. Failure to recognize the importance of these, and to consider them in the treatment of the acute stage of the disease, may lead to the development of chronicity.

As pointed out in former articles on acute empyema \* there are so-called typical cases, usually following lobar pneumonia, of pneumococcus origin, in which the pus settles by gravity in the lower thorax, on the outer surface of the lung, and becomes walled off there. Drainage of such a case will usually lead to cure in a short time without any difficulty. The chief point to be considered is to make a good opening at the dependent part of the cavity. Healing of such a case may be hastened by irrigation and artificial sterilization. If the disease becomes chronic, it can usually be traced to some gross error in technic, or to failure to recognize simple surgical principles, and it can truly be said of such a chronic case, that it was avoidable.

There are, however, many cases of acute empyema which differ from the so-called typical case. These are more often found in the streptococcus infections, but also in pneumococcus infections which follow a secondary or broncho-pneumonia. The exudate in these cases may be very extensive, it may surround a lung, it may be partly situated in the mediastinum, or it may become encapsulated where access to it is difficult. There may be adhesions, either old or recent, that divide the cavity into several compartments, and may lead to separate cavities or recesses. There may have been a perforation of an intrapulmonary focus leading to a pyo-pneumothorax. The case may be one of latent tuberculosis with acute influenza and pneumonia grafted on top of it. It may be a real tuberculous empyema, with a secondary infection, not recognizable in its true light at the time. Any of these cases present problems, sometimes difficult to solve, and it is not always easy to foresee all possibilities. The aspect of a case during the acute disease is quite different from that a few months later, when it has become

---

\* Empyema-Analysis of 70 Cases at Base Hospital, Camp Jackson, Carl Eggers, Surg., Gyn. and Obst., April, 1919. Relative Value of Various Operative Procedures Employed in Acute Empyema. Carl Eggers, Journal A. M. A., October, 1920.

chronic. One may consider it safer in a badly septic case to make a good opening, even at the risk of getting a collapse of the lung, simply animated by the one feeling, to save life. We know that such a collapse can usually be avoided by the institution of closed drainage. On the other hand, I have seen collapse of the lung occur in the presence of a perfectly functioning closed drainage.

Chronicity in all these different types, if due to gross errors in judgment, or to failure to recognize causes, or failure to apply good surgical principles, is also to be classed as avoidable. On the other hand, there are some cases of acute empyema which from the very beginning show a tendency to become chronic, or which in the course of treatment develop conditions that are beyond control or not easily avoided. For this reason I have come to divide all chronic empyema cases into avoidable and unavoidable.

There is perhaps no disease in which continuity of treatment is more important than it is in empyema. Those surgeons therefore who perform their own operations and themselves carry out the after-treatment, or at least closely supervise it, will have better results than others. In many hospitals it is still a common practice to discharge empyema patients before they are completely healed. This may be at their own request, or because it is believed the treatment can be successfully continued in an out-patient department. With this necessitated change in treatment by a man not familiar with the details of the case, and with the increased liability to secondary infection in out-patients, the tendency to chronicity is increased.

The fact remains that quite a number of patients with this condition present themselves for treatment, and in order to treat them intelligently it is necessary to understand the causative factors and to be familiar with the pathology of the disease. Chronic empyema is a serious condition, requiring careful individual attention, and ingenuity, resourcefulness, patience and the application of sound surgical principles are demanded in order to bring many of these patients to complete cure.

During the war the importance of empyema in general, and later of chronic empyema, was early recognized by the Medical Department of the Army. It became the policy of the Surgeon General to collect patients with this condition in special hospitals, where they were put in charge of officers trained to care for them, or who showed enthusiasm and aptitude in the treatment. These officers therefore had an unusual opportunity to study the condition and to record their findings. It was my good fortune to be put in charge of one of these concentration places for chronic empyema, and during the last few months of my army service to be ordered by the Surgeon General to visit nearly all hospitals in which chronic empyema patients were treated. The observations made in this way, together with those in civil practice, form the basis for the opinions expressed in this paper.

During a four months' period in charge of the surgical service at U. S. General Hospital No. 12, at Biltmore, N. C., 192 patients with chronic empyema came under my immediate care. They are the ones chiefly

referred to in this paper. Under the policy mentioned above eighty patients had gradually been collected at this hospital previous to my arrival. Most of them had just recently come in, while a small number had been under treatment there for a long time. In the next few weeks following my arrival 112 additional cases were admitted. A few patients were healed and were simply awaiting the required standard as to weight, length of time since healing, etc., we had set as the minimum for justifying release from the Army. All other patients had discharging sinuses. Some of them were in



FIG. 1.—Showing absolutely collapsed lung in a case with a very extensive exudate unrecognized for two years.

very good physical condition, ambulatory, and able to stand exercise, while others were underweight, and still others in a septic state, confined to bed. In some patients it was simply a slight obstacle to healing that prevented their complete cure, while others had deep sinuses or cavities requiring long and careful attention.

Of the 192 patients, 170 were white and 22 colored. All were of military age. A few had their primary operation performed at this hospital and had since been on Carrel-Dakin treatment, but by far the greater number had been operated on at some other Army Hospital in the United States or had been returned unhealed from over-seas. They would usually arrive in groups of from four to twenty, representing the total empyema residue of their respective camp.

Questioning brought out the fact that these men had had essentially the same treatment as hundreds of their colleagues, who had in the meantime been discharged cured. Such statements would tend to disprove that chronic empyema is always or nearly always avoidable. They seemed to show that in these particular cases, those which had become chronic, some element was present which was overlooked in the routine treatment of cases or which resisted treatment. We set ourselves the task to determine whether the treatment given at any particular camp was more likely to be followed by chronicity than the treatment given at another camp. We learned in this way that nearly all the cases had been on Carrel-Dakin treatment, in some camps given in the prescribed manner, in others only one or two irrigations a day. Whether this treatment had been started immediately after operation or several days later, seemed to make no difference. The same thing held true in regard to the type of operation done. Of our cases 131 had rib resection done, and 61 some form of intercostal drainage, either trocar or stab incision. The impression gained ground that no matter what operation was done, whether a trocar catheter drainage, an intercostal incision, or rib resection, and no matter what treatment was used, whether simple drainage, regular Carrel-Dakin or irregular Carrel-Dakin treatment, a certain number of cases would become chronic. The information obtained in this way did not give us any definite findings.

I believe all these factors play an important rôle in acute empyema, not alone in regard to whether a patient lives or dies, but whether his convalescence will be short or long. In regard to the development of chronic empyema their rôle is less important except in one respect, namely, imperfect or inadequate drainage, which no matter what treatment has early been used, tends to chronic cavity formation. It is not enough to make a good opening in acute empyema, it has to be maintained.

We then began to look for other possible causes of chronicity. Did the type of pneumonia preceding the empyema, or the type of organism producing it, play any rôle? Investigation showed that the primary disease in these 192 cases was

Pneumonia .....	44	Bronchitis .....	4
Broncho pneumonia .....	12	Vincent's angina .....	1
Lobar pneumonia .....	4	Mumps .....	3
Bilateral pneumonia .....	7	Measles .....	12
		Tonsilitis .....	8
		Laryngitis .....	1
		Influenza .....	86
		Rhinitis .....	1
			116
	67	Gun shot wounds .....	9

What type pneumonia the group with forty-four cases represented is not certain; however, it is certain that but four cases of the total list are called lobar pneumonia. The pneumonia following the diseases in the second

group is secondary, usually broncho-pneumonia, and if we add these 116 cases to the majority of group 1 we find that most patients had a broncho-pneumonia preceding their empyema. This is important and especially interesting in connection with a report on a series of seventy acute cases of empyema reported by me in 1919 in which I showed conclusively that empyema following a secondary pneumonia is usually more serious and requires a longer convalescence than empyema following a primary lobar-pneumonia.

When we studied the organisms responsible for the empyema in relation to this question, we found unfortunately that in many cases there was no report of the original culture present. However, there was a positive report of hæmolytic streptococcus in sixty-two cases, pneumococcus in six cases, and staphylococcus in three cases. While admitting that such a fragmentary report is not conclusive, it nevertheless shows that streptococcus was the responsible organism in a large number of patients. On admission culture showed a mixed infection in nearly all cases, with streptococcus as the predominating organism.

Taking these two findings together, I feel justified in saying that empyema following secondary pneumonias, especially those due to the streptococcus, are more likely to become chronic than those empyemas following lobar-pneumonia, and due to the pneumococcus. Continuing our investigations we were impressed with the fact, that though we had found the predisposing causes for chronicity, there were local, usually mechanical factors responsible for chronicity in a given case. These I shall take up under their respective headings further down.

Under the heading of chronic empyema may be considered three types of cases. 1. Old unrecognized empyema. 2. Patients who have not healed in the usual time. 3. Recurrences.

1. *Old Unrecognized Empyema Cases.*—That patients with accumulations of pus within one of their pleural cavities may go for months before the condition is recognized is unfortunate, but nevertheless true. If we consider that empyema usually is a complication of pneumonia, and that it sometimes becomes fully developed only late, it behooves us to examine carefully all those convalescent pneumonia patients whose general condition does not improve satisfactorily.

In acute empyema the pus usually collects by gravity in the lower thorax, and with typical signs the detection of massive exudates should present no difficulties. It is surprising therefore that even large collections are sometimes overlooked. A patient came under my care sometime ago who had apparently carried an extensive exudate for twenty-three months. Following an attack of influenza in September, 1918, he had never been well, he complained of cough, weakness and dyspnoea. In spite of this he went to work in the mines and continued until he could no longer stand up. After that his treatment by a private physician consisted of electrical applications over the stomach. When he came under observation in the Public



Health Service in New York he showed typical signs of an extensive exudate on the right side, filling the entire thorax. There was no temperature. Repeated sputum examinations were negative for tuberculosis. Exploratory puncture showed pus which on culture grew pneumococcus as the predominating organism. Guinea-pig inoculations proved negative. The exudate was gradually released by means of air-tight drainage, and in the first 48 hours over 3000 c.c. were withdrawn. The lung was found to be absolutely collapsed and has remained so, and the patient is a chronic invalid, still under treatment for obliteration of his enormous cavity (X-ray picture 1). Another patient, No. 28 of the series here reported, had a large exudate for seven months, normal temperature, but a positive streptococcus culture. He had been punctured unsuccessfully fourteen times and been treated for unresolved pneumonia. With our present-day knowledge, and the means for diagnosis at our command, such a thing should not happen.

Pus collections in other but the dependent parts of the thorax, on the other hand, are sometimes very difficult to diagnose. These encapsulated pockets of pus



FIG. 2.—Small encapsulated empyema plastered against the upper lateral chest wall.

may be small or large and may be found anywhere within the thorax. They may be situated in the mediastinum, between the lung and the diaphragm, or plastered against the chest wall (Fig. 2). Interlobar pockets also belong in this class. Physical examination is often misleading and exploratory puncture negative. The greatest single aid in the detection of encapsulated pus is the X-ray, preferably a stereoscopic picture. Under guidance of such a plate exploratory puncture is more apt to be successful. The patients so afflicted have often for months after a pneumonia complained of weakness, dry cough, dyspnoea, pain in the chest and loss of weight. They are anæmic and look sick. Sometimes they have been treated for tuberculosis. The pus obtained by aspiration is usually thick, creamy in character, it may be sterile or it may grow organisms in pure culture, even though the temperature has been normal for months.

In the series here reported there were twenty cases in which the diagnosis had been made late, ranging from six weeks to eight months after pneumonia. If left untreated such collections of pus lead to chronic invalidism in one or more ways.

- a. They cause degenerative changes in the organs by septic absorption.
- b. They interfere with respiration and circulation.
- c. They lead to the formation of a rigid abscess wall with a tendency to chronic cavity formation.
- d. They may perforate into a bronchus or externally.

The treatment is the same as that for ordinary empyema, except that the incision must be made wherever the pus is found. It is advisable to resect part of a rib. Of our twenty cases only ten healed in less than three months, while ten became chronic in the sense in which the term is used in this paper, and several later had to have a radical operation, of which one died after an extensive intervention.

Unrecognized chronic empyema may well be put into the class of avoidable cases. During the war it became a rule in some army camps to X-ray every convalescent pneumonia patient before his discharge, a practice which may profitably be adopted by civil hospitals and in private practice.

2. *Patients Who Have Not Healed in the Usual Time.*—The classification of chronic empyema under this heading is an arbitrary one for there is no fixed time in which an empyema should heal. From a study of acute cases it appears that healing usually takes place in from one to three months, with a tendency to a shorter convalescence in the cases following a typical lobar-pneumonia, than in those following a secondary or broncho-pneumonia. For this reason it seems fairly satisfactory to make three months the arbitrary time at which to consider a case chronic. This does not mean that when a patient has not healed in three months there must necessarily be a change in treatment. It does mean, however, that when an empyema continues to drain longer than is usually the case, it becomes necessary to look into the condition very carefully and find out what is the obstacle to healing. It may not be necessary or advisable to do anything except to patiently continue the drainage or irrigation treatment with attention to details. In other cases it may become necessary to remove the condition interfering with healing.

In the attempt to bring about healing, many of our patients had been operated upon several times, as the following table will show:

TABLE I.

No. of operations .....	1	2	3	4	5
No. of patients .....	73	67	37	13	2

In spite of this, healing had not taken place, and though some patients had drained but several months longer than the usual time, others had existed well over a year and showed no tendency to heal.

TABLE II.

Length of time of draining.																		
No. of months .....	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
No. of patients .....	8	21	25	34	39	15	14	4	7	3	5	2	2	8	3	1	1	

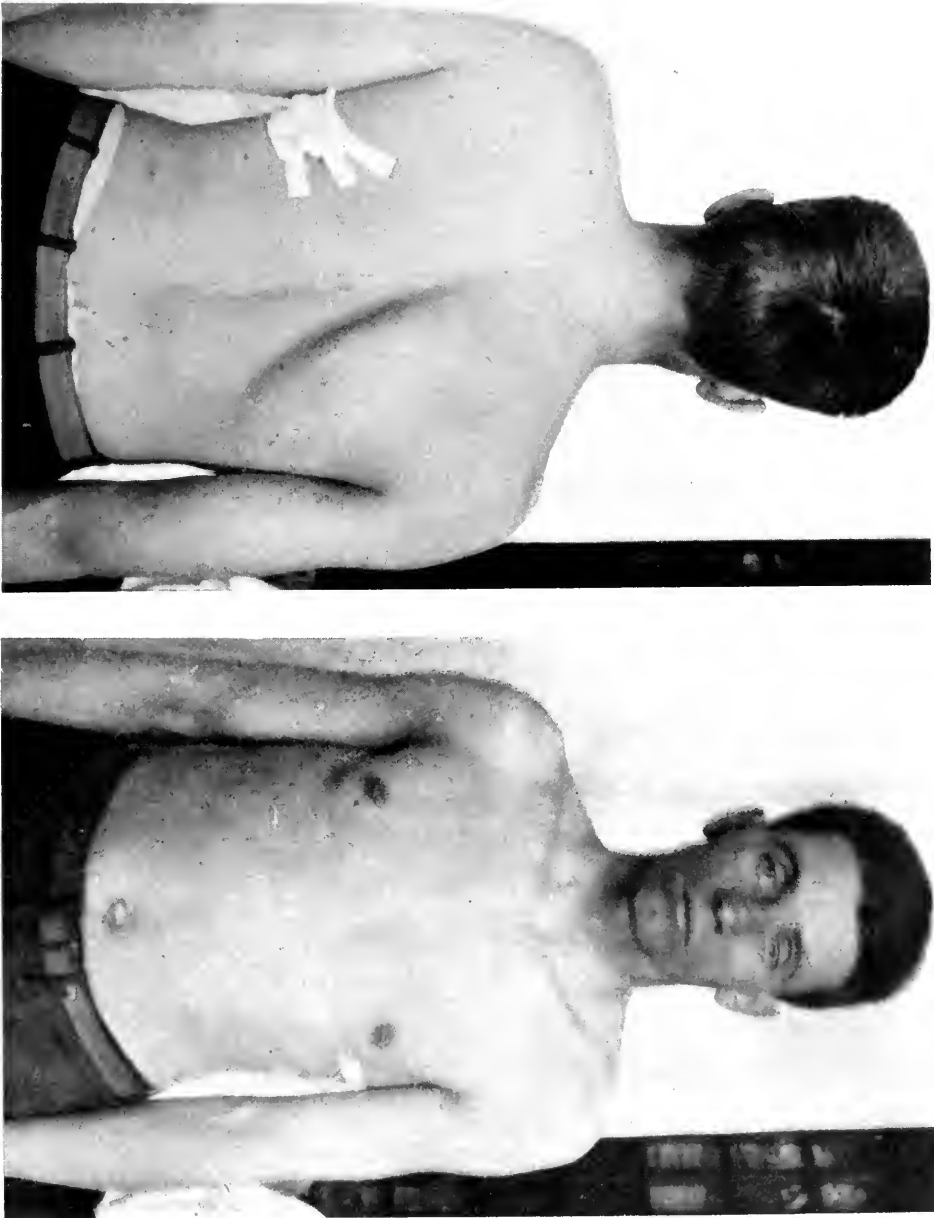


FIG. 3.—Showing deformity in a typical case with repeated recurrences.

The various conditions found in our cases, and interpreted as the causes of chronicity, will be discussed in detail further down.

3. *Recurrences.*—Quite a number of patients give a history that they had healed and reopened while still in the hospital. Others had been discharged healed and were later readmitted with a draining sinus following spontaneous opening of the old empyema wound. Still others came in before rupture had taken place, complaining of pain in the side, temperature, loss of appetite, and perhaps a dry cough. This last group requires surgical intervention, but because of the difficulty in knowing where to go in, it may be well to apply poultices and wait for a spontaneous rupture, which usually occurs through the old scar. What is the cause of such recurrences? There may be different causes, but in a general way it may be said that the longer a case has drained after the original operation, the more apt are recurrences to take place. This is due to the fact that the same causes which originally kept up drainage for a long time, operate to bring about recurrence.

Among our 192 patients there were fifty-nine who had a recurrence at some time in the course of their convalescence. Some of these were not true recurrences in that they occurred within a few days or weeks after healing had taken place, while others had been discharged cured and did not have a recurrence until several weeks or months later. Thirty-one of these patients had been on thorough Carrel-Dakin treatment after their original operation, and had apparently not been allowed to close until the wound was considered sterile, or proven so. Recurrences may occur regardless of the type of primary operation. It makes little difference whether a piece of rib had been resected or whether an intercostal incision was done. Recurrence had taken place because the drainage opening had contracted to such a degree that infectious material was retained, or because of the presence of some intrathoracic cause. These causes will be considered together with those held responsible for chronic empyema in general.

Patients with repeated recurrences often become quite disabled and deformed. Probably owing to pain an attempt is made to fix the thorax, resulting in curvature of the spine, elevation of the shoulder and flattening of the chest (Fig. 3).

*Causes of Chronic Empyema and Recurrence.*—Realizing that each group of chronic cases sent to us represented but a small residue of perhaps hundreds of cases treated at their camp in the same way, we did not feel justified in arbitrarily saying, they had not been treated right. The question was raised how much of a rôle their own general condition played. It must be conceded that constitutional causes such as syphilis, tuberculosis and anæmia play a rôle, and that complications in other organs will retard healing, but it was usually found that when a case did not heal properly, there was a local cause for it present. Studying any large group of cases of this type brings the conviction that chronicity in some could have been easily

avoided, while in others no criticism at all is justified. It always has to be borne in mind that the patient may have been extremely ill during the acute period of the disease and that the best under the circumstances was done.

When we began to study the reasons for delayed healing we found many different conditions, and we soon began to divide the patients into those with: A. Superficial fistulæ. B. Deep fistulæ and cavities.

*A. Causes of Superficial Chronic Fistulæ and Their Treatment.*—In this group we have put the various conditions that keep up discharge from a superficial focus. The empyema cavity has really been obliterated, but some inhibition in the healing process in the thoracic wall or just beneath it, keeps up a discharge. One condition may exist alone, or two or more may be associated. We have found the following causes to be responsible:

a. Epithelialization of the drainage canal.

b. Infected granulations.

c. Osteomyelitis of a rib.

d. Fistula leading to cartilage.

*a. Epithelialization of the Drainage Canal.*—

Occasionally one sees a case with a deep, drawn-in scar, at the bottom of which a fistula extends into the chest. The tissue surrounding the fistula is hard and rigid, and the fistula itself more or less completely epithelialized. At the bottom of the fistula a few granulations are present that bleed easily when a probe is inserted. The discharge is but slight, but on account of a little moisture constantly present the patient is annoyed. If kept dry by means of powder, healing may eventually take place, but on account of the epithelial surfaces coming in contact during respiration or movements of the body, chafing of the surfaces easily take place, and dried up secretions collect in the depth and give rise to irritation.

*b. Infected Granulations.*—A narrow tortuous canal has remained in many cases after the empyema proper has healed. A little discharge is constantly present. Healing is prevented by the presence of infected granulations along the canal and spreading out beyond under the adjoining ribs. The condition has often been stationary for months, and repeated attempts



FIG. 4.—New formed bone in periosteal bed of formerly resected ribs, and intercostal bridges in cases with intercostal drainage.

to bring about healing by cauterization or even curettage of the tract have been unsuccessful. The reason for this is that the granulations are lodged in the crevices of irregular new-formed bone, and behind it, where they are inaccessible to treatment. Local applications reach only the more superficial layers, while in the depth the infection continues.

*c. Osteomyelitis of a Rib.*—This condition may be found not alone in those patients in whom a rib has been resected, but also in those with an intercostal incision. In the former case it is easily explained by pus coming in contact with the exposed ends of the rib. A sequestrum may have formed, often very minute, and keep up the discharge. In other cases the new-formed bone may be diseased and be responsible for chronicity. In intercostal incisions the pressure of the drainage tube on the border of the rib above, or below, or both, may lead to erosion and infection. That an intercostal tube does give rise to considerable irritation may be seen by studying the resected portions of bone of such a case, which show grooves and new bone formation in the form of intercostal bridges (Fig. 4). In a recent case, a child with streptococcus empyema, a drainage tube in an intercostal incision led to osteomyelitis of a rib in three weeks.

*4. Fistula Leading to Cartilage.*—In anterior drainage openings in cases in which a part of cartilage has been resected, one may find a persistent tiny fistula long after the empyema cavity has become obliterated. From time to time it may crust over, only to break down again. Though the condition gives rise to little trouble, the patient worries and his discharge from the hospital is delayed. Investigation shows the fistula leading to the ends of the resected cartilage, where chronic inflammation keeps up the discharge. Applications of caustics have failed to bring about healing.

*Treatment.*—When these patients come under observation they have often had so much conservative treatment without result, that it is unnecessary to waste time repeating similar procedures. However one may feel like trying. The fistula is usually so narrow that a tube cannot be introduced. In such cases applications of iodine, silver nitrate or pure carbolic may bring about healing. One may also use a small strip of gauze saturated with 5 per cent. dichloramine-T. If more radical treatment is deemed advisable, a curettage of the tract with subsequent local applications may lead to a cure. However, in some cases no results are obtained, and it is then advisable to resort to a more radical procedure, namely complete excision of the entire affected area. This treatment is applicable to the first three groups of cases. The operation may be done under local or general anæsthesia because the patients are in good condition by the time they have a narrow residual sinus, and they have been ambulatory for some time.

Of our series of 192 cases, twelve belonged to this class. The operation is done as follows: An elliptical incision is made well beyond the fistula and completely surrounding it and part or all of the scar. The incision is carried right down to the bone and the muscles and skin are then pushed back. If a

rib had been resected at the original operation a bony ring may be found with the fistula passing through to the granulations beyond, while in intercostal incisions one may find more or less complete bony bridges (Fig. 4). Depending on the case, one or two ribs are divided in normal structure, gently elevated to see what is beyond, and the incision then carried into the thickened pleura beyond the granulations. All infected tissue, the skin with the sinus tract, ribs and all granulation tissue with surrounding thickened pleura, is then removed in one piece. If a narrow fistula extends beyond this area, it must also be completely extirpated. By undermining the muscles and skin it is possible to do a complete muscle suture. Often one may turn the cut surfaces inward to obliterate the remaining cavity. A small split rubber drainage tube is inserted between the sutures, and the skin then closed. By this method one not only removes an offending sinus that has caused trouble for months, but one overcomes the local deformity produced by a long draining sinus. Removal of all infected tissue likewise prevents recurrence. The muscle suture will completely overcome any depression at the site of operation and help to restore good function.



FIG. 5.—Large chronic cavity filled with bismuth.

Of the eleven cases operated upon in this way we obtained the following results: Ten healed in an average of nineteen days; one healed after a long time on account of a bronchial fistula.

The treatment of a fistula leading to cartilage is well illustrated by the following case. Patient F. B., operated on October 15, 1918, for empyema. Part of the fourth right costal cartilage was resected. Three weeks later the eighth rib was resected, posteriorly. This latter wound healed in February, 1919, but the anterior fistula continued to drain. Applications of irritants failed to heal. In March, 1919, an attempt had been made to cure the fistula by operative means, also resulting in failure. In May, 1919, I operated upon this patient. The incision was made in clean tissue, surrounding the fistula, which led to the fourth costal-cartilage. The latter was removed in its entirety, together with a short piece of the fourth rib and a small portion of sternum. The wound was closed without drainage and healed firmly in one week and has remained so. Cartilage heals poorly and it is therefore advisable to resect beyond it in bony tissue.

*B. Causes of Deep Chronic Empyema Fistulae and Cavities and Recurrences.*—Although frequently considerable distinction is made between a

fistula and a cavity, the two conditions represent but different stages of the same process. The difference between a cavity and a fistula is simply one of size. In the former we deal with a real cavity, which may be small or so large as to occupy the greater portion of the thorax (Fig. 5). In the latter we deal with a narrow contracted cavity, often very long and tortuous and extending sometimes to the apex of the thorax (Fig. 6). Either class of patients represents a condition that has been stationary for months or which progresses very slowly. The amount of discharge may be small or profuse, it may be serous or creamy pus. The opening in the chest wall may lead

directly into a large cavity, or it may communicate with the cavity by a narrow sinus.

What are the reasons these patients continue in this chronic state for months or years? Why do they not heal as others have done? The different causes of chronicity as found in our series are given in the list below and each group is then elaborated upon.



FIG. 6.—Small fistulous cavity with narrow extensions.

One or more of these conditions may be associated. 1. Contracted drainage opening. 2. Improperly placed drainage opening; (a) too high, (b) too low, (c) too far forward. 3. Pockets and recesses. Separate cavities. 4. Infected lining membrane of cavity. 5. Rigid unyielding cavity. 6. Pneumothorax. 7. Bronchial fistula. 8. Foreign bodies. 9. Tuberculosis. 10. Dakin solution. 11. General constitutional conditions.

*1. Contracted Drainage Opening.*—This is the most common condition found in all chronic empyema cases. No matter whether a rib was resected at the primary operation or whether simply an intercostal incision was made, the opening has finally become so small that a drainage tube cannot be introduced at all, or one so small as to be unable to properly carry off secretions. If cases with an intercostal incision are drained a long time, the pressure of the tube will cause sufficient irritation of the adjoining ribs to stimulate new bone formation, which in time produces bony bridges. As the amount of bone increases, the opening will gradually contract. If the tube is left out for a while, or if its calibre is gradually reduced, no drainage or insufficient drainage is the result. Consequently there is damming back of pus which keeps up the chronic infection of the cavity. A similar condition develops if a sub-



periosteal resection of a rib is done. New and often irregular bone formation develops in the periosteal bed and gradually shuts in the tube and contracts the opening. Unless the precaution is taken to keep the same large calibre tube in place the opening will soon contract to such a degree that imperfect drainage is the result.

Many surgeons to-day use the intercostal incision in acute empyema because they feel that it gives adequate drainage and they hope thereby to prevent osteomyelitis of a rib. That the first contention is correct is proved by many healed cases, but that the second one is not correct has been mentioned above. There are any number of cases to prove the contrary. For the reason that good drainage is more easily maintained if a portion of rib has been resected, I believe the best routine method of operating to-day is costectomy. By gradually reducing the length of drainage tubes, instead of their calibre, no difficulty is experienced in bringing the great majority of all acute empyema cases to a successful conclusion.

2. *Improperly Placed Drainage Opening.*—In discussing this subject we have to consider what is the best routine incision. In a typical empyema case the fluid collects by gravity in the lower thorax. Experience has shown that the costophrenic sinus usually becomes obliterated quite early, so that the floor of the cavity is found opposite the eighth or ninth rib. In these patients therefore resection of a portion of the eighth or ninth rib, or an intercostal incision in the eighth or ninth interspace, just external to the angle of the scapula, will place the drainage at the most dependent part of the cavity. The incision should always be made in such a way that good drainage will result while the patient is in bed on his back. Such an incision will give equally good drainage in the erect position, and that is important, for the aim in empyema is to get the patient out of bed early. The above-mentioned incision is therefore recommended in the typical case. Any variation from this may lead to imperfect drainage. Thus we have found that the drainage opening may be too high, too low, or too far forward. If it is too high, sacculation of pus is the result. In such a patient it will be necessary to change his position at dressing time in order to adequately clean out the cavity. At the next dressing a similar condition is found. In the desire to place the drainage opening at the lowest part of the cavity it is sometimes made too low. If, for instance, the tenth or eleventh rib is resected, imperfect drainage is also likely to result, because in the attempt to obliterate the costophrenic sinus the diaphragm becomes adherent to the chest wall, firmly enclosing the drainage tube. The latter finally will enter the cavity above only through a narrow sinus. As soon as the tube slips out, or is left out, a valve-like action takes place, closing the fistula, allowing damming back of pus, and favoring chronicity (Fig. 7).

A similar condition is apt to occur if the opening is made too far forward in the same rib bed. Valve action will here also develop and lead to imperfect drainage. With any of these improperly placed openings chronicity is of

course more likely to result if the drainage opening is at the same time allowed to contract.

In patients with encapsulated empyema the drainage has to be established wherever pus is found. One sometimes feels very fortunate in finding it at all, after many unsuccessful attempts have been made. The question of drainage at the most dependent part can be taken up later. That it is sometimes very difficult to enter a small cavity is amply demonstrated by a number of cases that came to us. Case No. 28 had been unsuccessfully punctured fourteen times before he came to us, about seven months after his pneumonia, with the diagnosis of unresolved pneumonia.

In very sick patients one may find it at times advisable to establish drainage at a place not representing the dependent part of the cavity. The criti-

cism in these cases is not that the opening was made, but that no effort was made later to correct the condition. If after several weeks one finds that there is poor drainage on account of an improperly placed opening, the condition should be corrected. One should not allow months to pass and the patient to become a chronic invalid.



FIG. 7.—Empyema cavity with a narrow fistulous outlet situated very low and responsible for imperfect drainage.

3. *Pockets and Recesses—Separate Cavities.*—These are more

common than is ordinarily believed. Not every empyema represents a smooth-walled globular or flattened cavity. In the attempt to wall off a suppurative fluid within the pleura, adhesions form between the lung and the chest wall, and sometimes divide the cavity into several compartments. In other cases old adhesions may be present from a former pleurisy. When the empyema is drained, the lung will gradually expand. Unless one has been dealing with a smooth cavity, this expansion will be irregular, and in this way small compartments or recesses are shut off from the main cavity. They may continue to communicate with the main cavity by a narrow fistula and for a while drain into it. As the expansion of the lung increases they may become entirely shut off and in this way a separate cavity may develop. Pockets and recesses may be found anywhere near the margin of the cavity, extending upward, to the mediastinum, or downward. The most common ones are found to extend into the costophrenic sinus, either forward or backward, sometimes several inches deep. These recesses represent narrow

## CHRONIC EMPYEMA

tortuous sinuses, lined with infected granulation tissue and sometimes contain pus in their distal end. They are responsible for continuation of infection in the main cavity, as well as for recurrences.

If a patient is observed carefully during his convalescence such pocketings of pus may be diagnosed and steps taken to drain them. As long as they communicate with the main cavity they may be recognized by the following:



FIG. 8.—Separate empyema cavity in a patient in whom one cavity is being drained through a resection of the ninth rib, posteriorly. This cavity was later drained by a resection of the seventh rib, more anteriorly.

During irrigation it will be found that after a while the fluid returns clear. If the position of the patient is now changed and pus again flows, or if it flows upon coughing or straining, the existence of a pocket is strongly to be suspected. An X-ray taken after the injection of the cavity with bismuth will usually clear up the diagnosis. If a pocket becomes completely shut off, a little temperature may develop, and the patient may complain of pain and increased dyspnoea. Sometimes these pockets break spontaneously into the main cavity, in other cases they are opened by an exploratory forceps intro-

duced at dressing time. Sometimes, however, an entirely separate cavity exists that has apparently had no communication with the main cavity. In the presence of an open thorax physical signs are misleading, and in such cases the greatest aid in diagnosis is the X-ray. Figure 8 represents such a separate cavity, existing in a patient in whom another cavity is being drained through a resection of the ninth rib. The pocket shown was later drained by resection of a portion of the seventh rib, more anteriorly. This pocket was suspected a few weeks after the original operation, because the return flow from the cavity was clear and still the temperature did not go to normal.

Pockets and recesses are more common in the empyemas following a broncho-pneumonia and of streptococcus origin, than in those typical pneumococcus empyemas following lobar pneumonia.

The use of the X-ray during convalescence is strongly to be recommended. It helps one to localize pockets, to note diminution in the size of the cavity, and it enables one to take steps early to counteract any influences tending to chronicity.

4. *Infected Lining Membrane.*—In patients who have drained a long time, especially in those in whom retention has taken place from time to time, or who have a contracted drainage opening, the abscess wall eventually becomes very thick, varying from one-quarter to three-quarters inch. Establishment of improved drainage, followed by Dakinization, sometimes leads to a cure. In other cases healing fails to result. Investigation led us to look for the cause in the wall itself. On the theory that the abscess wall of an old empyema is similar to that of other suppuration wounds, as for instance osteomyelitis, we had sections made of the parietal pleura. In many instances we found collections of round cells and minute abscesses. Frequently it was possible to demonstrate cocci in these little abscesses. It appears therefore that it is the breaking down of these abscesses that leads to reinfection and recurrence in a certain number of cases.

5. *Rigid Unyielding Cavity.*—Without any other complication, and with good drainage established at the dependent part, a cavity will at times refuse to heal. As long as organisms are present they may be held responsible, but after the cavity has been sterilized and healing still refuses to take place, we have to look for other causes. Nature has done all she can do by drawing in the chest wall, pushing up the diaphragm and pushing or drawing out the lung. The walls are simply so rigid that they cannot approximate. Sometimes closure will take place if a sterile dressing is applied and the cavity sealed without disturbing it. It has been found that the edges may join and that by a gradual absorption of air the cavity will obliterate after several months. This is however an uncommon observation. Sometimes it is impossible to sterilize a cavity, even with the most scrupulous attention to the details of the Carrel-Dakin treatment, and the discharge will continue. These patients have to be subjected to a radical operation.

6. *Pneumothorax*.—Any large empyema cavity is apt to be called a pneumothorax. It is my belief, however, that this term should be reserved for a certain type of case, which differs in its development from the usual empyema. The essential difference is that in ordinary chronic empyema we deal with a compressed lung, while in pneumothorax we are dealing with a collapsed lung. The pathological picture of the two conditions differs in various important points, and the mode of formation is different. In ordinary empyema the fluid develops slowly, and as it increases, the lung is gradually compressed, the fluid being surrounded by a wall of adhesions which keep it away from the free pleural cavity. When such an empyema is opened, the lung will not collapse, it may even partly reëxpand immediately, because the pressure of the fluid has been removed. Such a cavity is a true empyema cavity. Pneumothorax, on the other hand, is produced in one of



FIG. 9.—Typical chronic pneumothorax filled with bismuth.

two ways, either by the perforation of a lung abscess, leading to pyo-pneumothorax, or by an early operation at a time when no adhesions have formed to hold the lung to the chest wall. In either case the lung collapses and remains in that condition. This is the reason pneumothorax presents so much difficulty in healing.

In chronic empyema, the cavity may be any size or shape, but it will be found that the lung is adherent to the chest wall at the apex, as well as at the sides, so that a portion of it is functioning. In a pneumothorax, on the other hand, we have one large cavity extending from the diaphragm to the apex of the thorax. The lung has completely collapsed towards the mediastinum, and is thrown out of function. In the X-ray the visceral pleura is shown as an almost straight vertical line, and after bismuth injection a long vertical cavity is shown (Fig. 9).

In the entire series here considered there were only eight cases with a pneumothorax. I think the reason we did not have more is because most of the patients who developed an acute pneumothorax died. These cases simply represent the survivors. With the recognition of the importance of acute pneumothorax, and the value of delayed operation, as well as with the improved methods of closed drainage in those patients, in whom early operation is indicated, chronic pneumothorax should come under treatment less often than heretofore.

It is a difficult condition to heal, and because the lung collapses, changes take place in its tissue which do not favor reëxpansion. Unless the condition is recognized early, before fibrous tissue bands extend from the pleura into the lung parenchyma, it is impossible to bring about inflation of the lung. If recognized early, good drainage combined with arm exercises and the use of blow-bottles, may bring about a cure. In late cases radical operation aimed at obliteration of the cavity, is indicated. Some of the most difficult problems in this series were presented by patients with a chronic pneumothorax.

7. *Bronchial Fistula*.—I have considered this subject in a separate paper,<sup>†</sup> to which the reader is referred. As stated therein, large bronchial fistulæ are the result of traumatism from without, perforation of a lung abscess, or operative intervention for a lung abscess. Those opening on the skin have to be attacked surgically, and closed. Those opening into the pleural, or rather empyema cavity, will usually close spontaneously. This is especially true of the smaller communications which may be real bronchial openings or simply abrasions of the lung parenchyma. The larger ones may refuse to heal and be responsible for the persistence of a chronic empyema. In such cases a radical operation is indicated, the aim of which is mobilization of the chest wall and the lung. This mobilization brings about the mechanical conditions necessary for healing. Recognition of these bronchial communications usually presents no difficulty.

8. *Foreign Bodies*.—Two types of foreign bodies have to be considered, tubes accidentally lost in the cavity, and foreign bodies introduced from without, usually the result of gunshot injuries. The former are an avoidable cause of chronicity, while the latter are not. In our series we had twelve cases in which at some time in their convalescence a foreign body was found, a rubber tube in five and a bullet or shell fragment in seven.

The question may be raised whether these foreign bodies are the cause of chronicity, or whether they are simply incidental to it. They may be alone responsible for keeping up a discharge and their removal will lead to prompt healing, or they may be removed and the discharge will continue just the same. This is due to the existence of some other cause of chronicity, such as inadequate drainage. Sometimes a foreign body may heal in and later lead to recurrence, or it may become entirely encapsulated.

<sup>†</sup> The Treatment of Bronchial Fistulæ by Carl Eggers. *ANNALS OF SURGERY*, September, 1920.

To avoid loss of a tube, one should always keep a pin through its outer end, but in spite of this a tube may slip in by the pin cutting through. This has been repeatedly observed. For this reason it is advisable that the same person dress the patient on successive days, so that the loss of a tube may not escape attention. If a tube has been lost, its removal may be simple or quite difficult. It may be possible to grasp it with forceps and extract it. In other cases it may float into view or even out of the wound during irrigation, especially if the cavity is filled while the patient lies on his normal side. Sometimes it is necessary to enlarge the opening to extract it.

The diagnosis can usually be made by means of the X-ray. The better, or rather the purer the rubber, the less apt is it to show on the plate.

In gunshot cases it is not only projectiles that keep up a discharge, but other foreign bodies, as pieces of uniform or leather may be responsible.

9. *Tuberculosis.*—Typical cases of tuberculous empyema are not to be considered here, but only those cases which have been considered empyema of ordinary origin, and in which on account of chronicity special effort has been made to make a diagnosis. The general condition of these patients is often quite good, but some of them are physical wrecks.

In any patient, in whom a discharge continues for a long time, in spite of good drainage and irrigation treatment, tuberculosis must be considered.

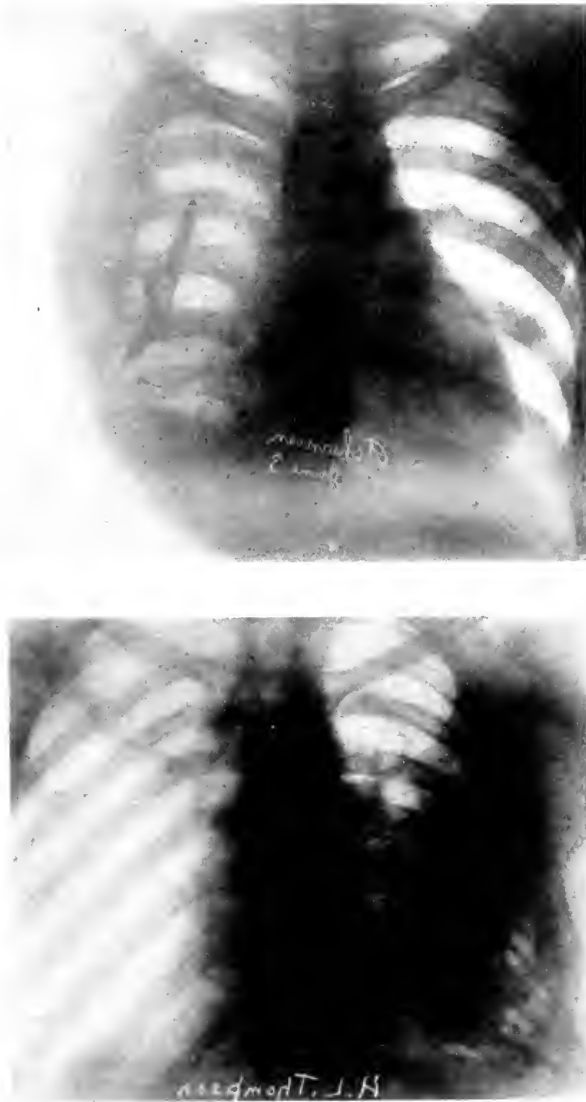


FIG. 10.—Chronic cavities filled with bismuth, showing variation in position, size and shape.

Tubercle bacilli can sometimes be demonstrated in a smear from the discharge. In other cases a guinea-pig injection may be positive. In still others one may make the diagnosis on a section of excised pleura. The patient may have tubercle bacilli in his sputum, and may have been suspicious of pulmonary tuberculosis before he developed empyema, or he may have an old healed apical lesion. Sometimes no intrapulmonary focus can be made out at all, even in the presence of a positive tuberculous pleuritis. The presence of tuberculosis does not preclude the possibility of healing. Even these cases are favorably influenced by Carrel-Dakin treatment, and may heal. In other cases a radical operation may lead to a cure. In still others the general condition is of prime importance. They have to be subjected to a regular course of anti-tuberculous treatment, being content to keep the wound clean. The use of iodoform oil injections in these patients is recommended, combined with sunlight treatment. A tuberculous empyema, recognized as such should not be opened unless secondary infection has developed.

In our series there were two proven and eight suspicious cases of tuberculosis. Of the latter, two have since died of tuberculosis.

*10. Dakin Treatment.*—Occasionally a case comes under observation in which Carrel-Dakin treatment has been faithfully followed for a long time without having been able to produce healing, even if sterility had been obtained or if the case was clinically sterile. In the absence of other factors that could be held responsible, we have resorted to the simple expedient of removing the tubes and discontinuing all irrigations, and have been gratified to see the empyema obliterate and the wound close in a very short time. A well Dakinized cavity will become dry in a remarkably short time after stopping treatment. In some of these patients it appears that the presence of Carrel tubes acts as an inhibitory agent and prevents expansion of the lung, and the Dakin solution itself acts as an irritant and keeps up the discharge.

*11. General Constitutional Condition.*—This subject is considered last, not because it is of little importance, but because it plays after all a secondary rôle. As mentioned before, it has been our experience that in practically all chronic empyema cases there is a local condition to account for the chronicity. On the other hand, it is also true that, the local conditions being favorable, and drainage well established, healing will take place more rapidly in those patients in good condition and with no constitutional disease than in those who may have been weakened by the co-existence of other conditions. The aim is therefore to improve the general condition of the patient while drainage is going on. This is best done by the administration of wholesome general diet, with the addition of milk and eggs. Deep breathing exercises, arm exercises and fresh air and sunlight, are all of great importance.

*Diagnosis.*—A diagnosis of the severity and extent of the condition is necessary for intelligent treatment. First in order is a careful history, especially in regard to the antecedent disease, in order to determine whether the patient is more likely to have had a lobar or a broncho-pneumonia, or whether tuberculosis has to be considered. It is necessary to inquire regarding the



presence of cough and the kind and amount of expectoration, for this gives information as to the likelihood of an associated lung abscess. Whether Dakin solution is well borne or not, as in cases with bronchial communication, has to be determined. This is followed by a physical examination and cultural examination of the discharge. The thoracic fistula is carefully examined, whether it is superficial or deep, whether it has contracted, whether it leads to rough bone. The cavity is then measured and an attempt is made to determine whether retention and pocketing exist. An X-ray of the chest is taken for general orientation and the possibility of the presence of a foreign body. For accurate understanding such an X-ray is usually unsatisfactory, but it shows whether there is thickened pleura, or a secondary pocket, or fusion of ribs, or sometimes osteomyelitis. The most important aid in the diagnosis is obtained by injecting the sinus or cavity with an opaque fluid and then taking a stereoscopic X-ray. If it is possible to insert a catheter, it is passed to the apex of the cavity and the opaque solution injected, otherwise a blunt-nosed glass syringe is put into the sinus opening and the injection

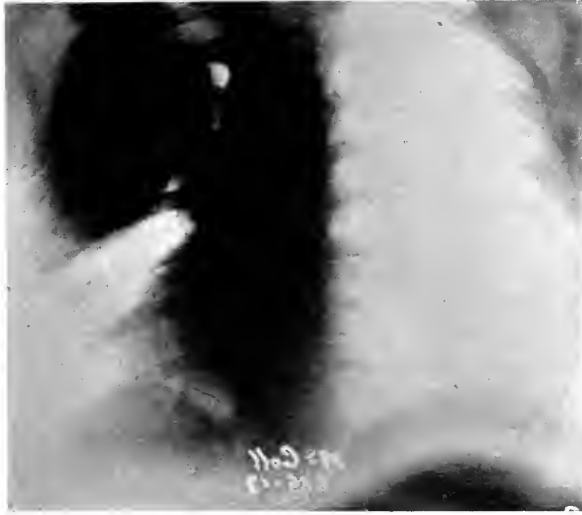


FIG. 11.—Chronic empyema of posterior chest, draining through an anterior fistula. Diagnosis made by bismuth injection.

done in that way. We use for this purpose a suspension of bismuth subnitrate 20 per cent. in cottonseed oil, and add to this 3 per cent. acacia. This oil is easily injected, gives an excellent picture, and has the additional advantage that it will flow out readily after the pictures have been taken. Excellent outlines of cavities and sinuses with their ramifications are obtained in this way (Figs. 10 and 11). After the cavity has been emptied by the patient straining, another picture is taken. This gives valuable information, for in this way one can see whether there is bismuth retention in narrow recesses or pockets.

We have seen no untoward effects from the injection of this bismuth emulsion. No symptoms of poisoning have been encountered. The precaution should be observed to inject slowly and without too much force, interrupting from time to time to allow air bubbles to escape.

*Complications.*—Most of the so-called complications of chronic empyema are really complications that developed during the acute stage and are carried over into the chronic stage.

The most common one is anæmia, ranging from mild affections to very severe secondary anæmia. It is due to sepsis, especially streptococcus sepsis. Free drainage of the empyema cavity, Carrel-Dakin treatment, plenty of nourishing food, medicines, fresh air and light exercise out of doors help to restore the blood condition to normal. Among the real complications endocarditis, myocarditis, and multiple arthritis are the most important. The heart of some of these patients is very rapid, accompanied by dyspnoea on slight exertion, which is not accounted for by the throwing out of function of the lung on the affected side. Displacements of the heart with fixation in abnormal positions may be responsible. In most patients the heart condition recovers, while a few remain chronic invalids. In our entire series there were four cases with a real endocarditis. Joint involvements are also not common. Transitory joint pains are frequently encountered, especially in patients with a contracted drainage opening, and in recurrences. Pain in the joints is sometimes the first symptom patients with a recurrence complain of. It is no doubt due to absorption of toxic material. Severe joint involvement was encountered in only four cases, and in two of these it was due to the use of Dakin solution.

Lung abscess is really the primary disease in some cases of empyema, and should therefore not be considered here as a complication.

Bronchial fistulæ have been mentioned above.

One of our cases developed an acute streptococcus septicæmia after he had been healed for a few weeks. Although he looked like a hopeless case, he recovered after the administration of large doses of anti-streptococcus serum and three blood transfusions from a patient who had recovered from a streptococcus empyema.

*Treatment.*—Treatment directed towards improving the general condition is carried out coincident with attention to the local condition.

The patients are put on a liberal mixed diet, and milk and eggs are given between meals. They are kept out of doors whenever the weather permits. Deep breathing is encouraged and lung expansion with the aid of blow-bottles is practiced. Light arm exercises are begun early, and as soon as the general condition of the patient permits regular setting up exercises are carried out and gradually increased. These exercises aid expansion of the lung, they bring about better oxygenation of the blood and better emptying of the cavity. The patients with chronic empyema are often depressed and discouraged, and it is necessary to instil a more hopeful attitude. This can be brought about by having them associate with patients similarly afflicted, but nearer a cure.

The local treatment has to depend on the conditions found on admission. Superficial sinuses and their treatment have been discussed above. We are here concerned with deep sinuses and with cavities. Regardless of the underlying condition we have put these patients on Carrel-Dakin treatment with the idea of improving the condition of their wound and to clear up sepsis. The great majority of the patients have insufficient drainage when they come under observation, either due to a contracted drainage opening, or to an

improperly placed drainage opening. The first concern therefore is to give them an opening sufficiently large to allow the introduction of antiseptic solutions and to assure free exit. This is done in various ways either by the gradual dilatation of the existing opening, or by an operative enlargement of the opening or by the establishment of a new opening at the dependent part of the cavity. The simplest way is tried first, either by choice, or because the patient objects to anything requiring a knife. In many patients it is possible to bring about gradual dilatation of the drainage canal with the aid of a stiff catheter or bougie. This catheter is allowed to remain in place 24 hours and the following day a larger one is introduced. By these means one can often get enough dilatation to admit one or two Dakin tubes and an outlet tube. Regular Carrel-Dakin treatment is now started, using an amount somewhat less than the capacity of the cavity. Quite a number of cases are cured in this way.

If a bony ring has formed around the sinus opening, making dilatation impossible, it is best to operate. Short pieces of one or two ribs are resected under local anæsthesia and the entire fistula dissected out. Several Dakin tubes and an outlet tube are inserted and the treatment started at once. It is surprising how quickly many of these patients will clear up after good drainage is established and the old infected sinus tract removed.

If it is found that sacculation of pus takes place, due to a drainage opening placed too high, a new incision is made at the dependent part of the cavity. The site of this new incision is determined upon after thorough study of the case with the aid of a probe or an X-ray after bismuth injection, or both. At the time of operation the old sinus is curetted and is then allowed to close.

In patients who resist this treatment other causes have to be looked for. A foreign body may be present which, if accessible, must be removed, and conservative treatment then continued. In case a lobulated cavity is present or a separate cavity, a counter-incision may clear up the condition. The majority of chronic empyema patients are cured by the simple methods just described, but a certain number refuse to heal. Drainage and superficial sterilization of the cavity alone, or combined with attention to the general condition of the patient are not sufficient. In these patients certain factors are responsible which do not yield to simple measures, and radical operation has to be resorted to. One may be dealing with a lung which has become so fixed in its position, that it is unable to expand, the lining of the cavity may be infected in its deeper layers and lead to reinfection, there may be recesses or pockets, we may be dealing with a collapsed lung, or with tuberculosis, or there may be a foreign body which is inaccessible, or there may be one or more broncho-pleural fistulæ. The treatment of all these conditions will be considered in a separate paper, to be published shortly.

*Carrel-Dakin Treatment.*—Though this method of treating suppurative wounds has been used now for a number of years, there is still no unanimity of opinion as to its value or usefulness. Some surgeons consider its introduction one of the greatest medical achievements of the war, while others are very emphatic in its condemnation. I was never swept away by the wave of enthusiasm that passed through the surgical world in 1917 and 1918, when

extraordinary claims as to its efficacy were made. In order to test the merits of Dakin solution, I used it extensively during the war in ordinary suppurative wounds as well as in empyema. In a paper on a series of acute empyema cases reported in 1919 ‡ I ventured to say that comparisons between cases treated with Dakin's or other antiseptic solutions and those with simple drainage failed to show any superiority in favor of Dakin solution. Nevertheless, I used it exclusively in another unpublished series of acute empyema cases and became convinced that by these means we were unable to materially shorten the course of the disease. The solution has, however, certain advantages. It keeps the wound clean, it does away with foul-smelling, disagreeable pus, and thereby prevents absorption of septic material. I believe in using it in acute empyema early in the disease only for one daily irrigation, and later, when the acute inflammatory reaction of the pleura has subsided, in the regulation manner. Even then I do not favor its continuous use, but rather prefer to use it at intervals for a few days only and alternate with several days of simple drainage. The burning and annoyance patients at times complain of are thus avoided, and during the periods of simple drainage blow-bottles may be used to advantage.

In chronic empyema, on the other hand, I believe Dakin solution to be of really great value. No one, who has seen a large series of cases cleared up by the scientific application of the Carrel-Dakin method can fail to be impressed. Of our 192 patients, 173 had received Carrel-Dakin treatment at some time during their convalescence before they came to us, given more or less according to regulations, and 19 had been treated by simple drainage. At our hospital all were put on intensive Dakin treatment as soon as proper drainage had been established. The solution was injected every two hours during the day and every four hours at night. The amount was slightly less than the capacity of the cavity. The wound was cultured once a week, and as soon as a sterile culture was obtained, the test was repeated every day without change in treatment. After seven consecutive cultures had been reported negative all treatment was discontinued and the wound sealed and left undisturbed for a week. At the end of that time it had usually closed or nearly so and simple sterile dressings were reapplied.

*Disadvantages of This Treatment.*—1. The patients are always wet, which is at times very annoying to them. We have tried to overcome this by having an inner and an outer dressing. The inner one consists of several layers of gauze surrounding the tubes, and is held in place by adhesive plaster strips to which tape is attached. This dressing is not disturbed during the day. The outer dressing consists of large pads reaching well down to the lumbar region, and is held in place by a binder. These pads may be changed by the nurse any time during the day or night.

2. The skin often becomes irritated. Some patients are so susceptible that they easily develop an eczema. The treatment is preventive. As a first

---

‡ Empyema. Analysis of 70 Cases at Base Hospital, Camp Jackson. Carl Eggers, New York.

requisite one should make sure that the solution is properly made. The skin should be protected with vaseline strips, smoothed out onto the skin so that no solution can get under it. These strips should run up to the wound edge, but not onto the granulations. Once an eczema is established, the use of the solution should be discontinued for a few days and drying ointments used in the meantime. Another important point is to clean the skin with alcohol at each dressing and to dry it before applying the vaseline strips.

3. Burning in the wound is usually complained of only by patients with acute empyema. It is due to the irritant action of the solution on the acutely inflamed pleura and on the cut surfaces of the soft parts of the chest wall. It is best avoided by using it as indicated above. Occasionally patients with chronic empyema complain so much that it is wise to discontinue its use for a few days or permanently.

4. Nausea, vomiting or diarrhoea are at times encountered, and do not yield until Dakin solution is discontinued. Nausea alone is quite common and is experienced by some patients at every injection of the solution, while actual vomiting or diarrhoea are encountered infrequently.

5. Arthritis was found to be due to the use of Dakin solution in two cases. The demonstrations were so decided that there was no doubt about the relationship. The arthritis in both cases was multiple in type, accompanied by swelling and redness. The pain was excruciating. It began to subside a few hours after discontinuing treatment. Repeated tests were made on both these susceptible patients. While they were entirely normal, Dakin solution was again used and in a few hours the pain and swelling in the joints became so severe that it had to be discontinued. Whether it is due to the action of the solution itself, or whether the solution liberates toxins in the empyema cavity which, when absorbed, cause the symptoms, could not be determined.

6. It seems that occasionally Dakin solution may be responsible for continuation of temperature. We had one patient, a bilateral empyema, in whom this was very noticeable. Careful examination had failed to reveal any complication, there was no pocketing, but the temperature went to 102 or 103 every evening. Discontinuing Dakin solution brought the temperature to normal in two days and it remained that way. A subsequent test again brought a rise of temperature, which again promptly subsided when the solution was stopped.

*Results Obtained.*—Of the 192 patients under our care 12 had a superficial fistula and were treated by complete excision of the tract with surrounding diseased skin, bone and pleura as described above.

All the other 180 patients were treated by the Carrel-Dakin method. This treatment was continued as long as there was reason to believe it would lead to healing. Of this number 62 showed no tendency to heal or conditions were recognized that interfered with healing. These patients were therefore subjected to a radical operation and are included in a paper on the radical operation for chronic empyema to be published shortly.

## CARL EGGERS

Of the remaining 118 patients, 104 healed in an average of 116 days from the last operation, and 14 were transferred unhealed. In these unhealed patients the chances for healing were good, they simply required more time, and they were therefore not operated upon.

In the four months' period I was in charge of General Hospital No. 12, from the end of April, 1919, until the end of August, 1919, when the hospital was closed,

- 141 cases were discharged healed.
- 45 cases were transferred to other hospitals.
- 4 cases were discharged unhealed at their own request.
- 2 cases died after a radical operation.

The healed cases were made up as follows:

After excision of superficial fistula .....	11
After Carrel-Dakin treatment .....	104
After radical operation .....	26
	<hr/>
	141

The group of cases transferred to other hospitals was made up as follows:

Unhealed, and still on Carrel-Dakin treatment .....	14
Unhealed after excision of superficial fistula .....	1
Unhealed after a radical operation .....	27
Healed, but transferred on account of complication .....	3
	<hr/>
	45

The patients of this group who were unhealed after a radical operation were convalescing. Some had been operated upon but shortly before they were transferred; they simply required more time. It is known that of these unhealed transferred patients,

- 19 healed soon after transfer.
  - 9 remained unhealed.
  - 2 died later of tuberculosis.
  - 12 have not been heard from.
- 
- 42

At the time of discharge we made observations on the physical condition of all patients and noted their chief complaint.

*Weight* is an important index of the patient's condition, and we utilized it in determining whether a patient was fit for discharge. It is an interesting fact that many empyema patients put on weight, considerably beyond their normal, while they are convalescing. At the time of discharge:

- 45 had their normal weight.
  - 40 were overweight.
  - 22 showed extreme overweight, 15 lbs. +.
  - 19 were up to 5 lbs. underweight.
  - 15 were up to 10 lbs. underweight.
- 

141

*Dyspnœa* in some degree was found present in the majority of cases. However, this applied chiefly to walking out of doors in rolling country. To the question: "Do you get short of breath?"

40 answered "no."  
82 had slight dyspnœa.  
3 marked dyspnœa.

---

141

*Chest measurements* were made with an ordinary tape measure, from the median line in front to the median line behind, at a level just below the nipples in front and below the angle of the scapula behind, with the chest at rest.

55 cases showed no difference between the two sides.  
43 cases measured 1 inch less on the affected side.  
34 cases measured 2 inch. less on the affected side.  
9 cases measured 3 inch. less on the affected side.

---

141

*Expansion* was rated by simple observation only, both from the front and from behind. It was found to be good in 87 patients.  
restricted in 47 patients.  
poor in 7 patients.

---

141

*Deformities* of 141 patients examined 66 showed no deformity.  
57 showed slight flattening of the chest.  
23 showed marked flattening of the chest,  
30 showed various degrees of curvature  
of the spine.  
11 had shoulder elevation on the affected  
side.  
14 had shoulder elevation on the normal  
side.

Flattening of the chest is not in all cases due to collapse of the chest wall. In many instances, especially in those less marked, it is due to atrophy of the pectoral muscles caused by non-use of the arm. Exercise will restore many of these to normal. When due to actual collapse of the chest wall, which represents one of nature's efforts to obliterate the empyema cavity, the deformity is permanent.

Curvatures of the spine also frequently respond to exercise, but if they have persisted for a long time, they may be permanent. Attention has been called to the importance of not allowing empyema patients to remain long in bed in a cramped position, but to get them out early and to encourage the use of their muscles. Some of the spinal curvatures are improved by radical operation which does away with the fixation of the chest caused by fusion of ribs and thickened contracted pleura.

Shoulder elevations are acquired postural deformities. The treatment is chiefly preventive. It must begin in the acute stage of empyema. Owing to pain or cumbersome dressings patients with empyema are inclined to assume different abnormal postures. Correcting positions early and encouraging patients to use their muscles and breathe deeply, especially while standing in front of a mirror so that they may observe themselves, are important factors in preventing permanent deformities.

All these observations were made on healed patients, in some about two months after closure of their wound, in others only two weeks after healing. Many of the lesser degrees of deformity will improve as time goes on, but it is nevertheless true that a large number of patients healed after having had chronic empyema for a long time are permanently damaged. They are usually able to follow their former vocation, but aside from varying degrees of deformity they have less endurance, they are apt to become dyspnoeic and they frequently have pain in the affected side. It should therefore be the aim of every surgeon treating acute empyema patients to prevent them passing into the chronic stage. Restitution to normal usually takes place if drainage has not been continued too long.

My sincere thanks are due the different surgeons and nurses of General Hospital No. 12 for their excellent spirit of coöperation, their devotion to duty and their attention to the details of the Carrel-Dakin technic, which made the described results possible. I want to especially thank Miss Elise Kudlich, not alone for her aid as an expert technician in the use of the Carrel-Dakin method, nor for her help in collecting information about patients, but for her sympathetic, cheerful and helpful attitude to the unfortunate and discouraged empyema patients who came under her care.



# INGUINAL HERNIA IN THE MALE

## LATE RESULTS IN 978 TRACED CASES

BY SEWARD ERDMAN, M.D.

OF NEW YORK

FROM THE SECOND SURGICAL DIVISION OF THE NEW YORK HOSPITAL

In the five-year period from January 1, 1915, to January 1, 1920, there were performed 1093 elective operations for inguinal hernia in the male, on the Second Surgical Division of the New York Hospital, under the direction of Dr. E. H. Pool.

To date there are 73 known recurrences, or 6.67 per cent. In addition there were 32 emergency operations for strangulated inguinal hernia in the male, which are not included in this report (as they will be published at a later date).

Of the 1093 elective operations, we have succeeded in adequately tracing 978 cases, or 89.5 per cent., and it is our intent to base the analysis of "late results," solely upon the 978 traced cases.

By adequately "traced," we mean that 908 cases have returned to the hospital for careful examinations by different members of the attending staff, not by the operator alone. We have included 70 cases reported by letters from physicians who had examined the individual, or letters announcing the acceptance for service in army or navy, or letters stating that a second operation for the hernia had been performed. Letters based solely upon the patient's own impressions have not been accepted by us as convincing.

Thus of the 978 traced cases, 92.84 per cent. have returned for examination, and 7.16 per cent. were traced by letter.

The follow-up system of the Second Surgical Division calls for examination of the patient on at least three occasions, respectively, at three months, at one year, and at two years after the hernia operation.

An analysis of the series here presented shows that the return visits actually averaged more than 2.5 for each patient, over periods ranging from the minimum of three months up to seven years.

Certain cases of doubtful prognosis or unusual interest have been reexamined as many as eight and ten times.

The operators in this series were nineteen surgeons, a large proportion being house surgeons but always under the immediate direction of a member of the attending staff of the division.

The known recurrences among 978 traced cases number 73, or 74.6 per cent.

We believe that actual examination of the patient at intervals after the hernia operation provides the only reliable criterion for estimating the number of recurrences.

The application of this standard will inevitably show a higher percentage of recurrences, but there can be no advantage in any evasion of the facts.

One occasionally reads a report of a series of cases by one individual

TABLE I.

	Operations	Recurred	Percentage
Oblique . . . . .	665	21	3.15%
Direct * . . . . .	313	52	16.61%
Total . . . . .	978	73	7.46%

\*In Table I, we have included under the term "direct", that mixed type often called "saddle-bag" or "direct-indirect", because we believe that in these cases it is the "direct" weakness which constitutes the surgical problem in repair and for other reasons of similarity which are to be mentioned.

surgeon, in which the results claimed are nearly perfect, but this must be regarded as unproven, unless a complete follow-up is used.

Certainly the records of the average surgeon and of the best hospitals will show a not negligible recurrence rate.

It is only with the recent introduction of adequate follow-up systems that anything approaching accuracy of statistics has become possible.

One of the most valuable and illuminating reports in recent literature on hernia was contributed by A. S. Taylor to the *Archives of Surgery*, Septem-

TABLE II.  
*Recurrences in Direct Hernia.*

	Operations	Recurred	Percentage
Direct (simple) . . .	256	44	17.1%
Direct-indirect . . .	57	8	14.0%
Total . . . . .	313	52	16.61%

ber, 1920, vol. i, pp. 382-406, entitled "The Results of Operation for Inguinal Hernia; Performed in the Johns Hopkins Hospital from January 1, 1899, to January 1, 1918."

Among 816 oblique herniæ, traced, there were 5.6 per cent. known recurrences; and in 94 traced direct herniæ the recurrences were 18.08 per cent.—Of the 94 direct herniæ, 47 were examined at the Johns Hopkins Hospital and showed 14 recurrences or 29.7 per cent.—The remaining 47 direct herniæ reported by letter only, adding 3 recurrences, but reducing the percentage for the 94 direct cases.—In the entire Johns Hopkins series slightly less than half were examined, the remainder reporting by letter.

At the New York Hospital we have found that a degree of care must be exercised in the examination of the returned patients in confirming the diagnosis of recurrence.

Allowance must be made for a slight degree of bulging and impulse along the structures of the cord, especially in those cases of direct hernia where the cord structures may have been transplanted outside of the aponeurosis.

Case 840, New York Hospital, was adjudged a recurrence by reason of such a bulge and impulse although no sac could be made out. This case was submitted to a second operation at which time a very careful search failed to reveal any type of hernia.

Five other cases which were recorded for a time as either "actual" or "doubtful" recurrences were later stricken from that classification after conscientious deliberation by the attending staff. These five cases were subjected to the closest scrutiny and to repeated examinations over periods ranging from two to five years, but failed to develop evidence of a sac and remained free from symptoms, although no truss was worn; in fact, there never was more than the slight bulge and impulse over the transplanted cord.

TABLE III.  
*Time of Recurrence Following Operation in 978 Traced Cases.*

	Operations	Total recurred	Recurrence first noted				Total within 2 yrs.
			within 6 mo.	between 6-12 mo.	between 12-18 mo.	between 18-24 mo.	
Oblique.....	665	21	10	6	2	2	20 or 95.2%
Direct.....	313	52	25	13	10	4	52 or 100.0%
Total.....	978	73	35	19	12	6	72 or 98.6%

This table shows that 47.9 per cent. of all recurrences were noted within six months after operation; 73.9 per cent. within 12 months; 90.4 per cent. within 18 months and 98.6 per cent. within two years.

It is essential that examinations should be made at intervals during the first two years in order to properly estimate the time of recurrence.

If a patient is not seen until several years after operation, it will be impossible to decide when the recurrence first developed.

We may state as a general proposition that a hernia which has not recurred within two years after operation is cured.

It appears to the writer that the small number of exceptions to this rule should not be considered as operative failures but occur as the effect of advancing years, weakening of the abdominal muscles, a fresh trauma, or other factors which are quite as likely to produce a hernia upon the non-operated side as at the site of operation.

Several causes for early recurrence become evident in the series studied; thus

(A) Direct sac overlooked at operation.

In five instances the operator stated that no sac was found, nevertheless within three months a definite hernia was present.

All five failures occurred in cases diagnosed as bilateral direct herniæ, and our experience would indicate that in such doubtful cases the peritoneum should be opened and the slack taken up, even if no definite sac be recognized.

(B) Cases of incomplete repair by reason of the physical condition of the patient on the operating table.

(C) Post-operative accident.

Case 770, aged seventy years, and alcoholic, developed delirium after an operation under local anæsthesia, jumped out of bed on the day after operation and presented a definite recurrence at the first examination, three months later.



FIG. 1.—Typical bilateral direct hernia. Note the egg-shaped swellings opposite external rings. Direct sacs seldom enter the scrotum.

#### GENERAL STATISTICS

During the five-year period, there were performed, including females, 1154 operations for inguinal hernia.

*Sex.*—Inguinal hernia in the male totaled 1093 cases, or 94.7 per cent. Inguinal hernia in females numbered 61 cases, or 5.3 per cent.

*Age.*—The youngest patient was six months of age, an infant with a large irreducible scrotal hernia; the oldest was a man of seventy years; both had oblique herniæ.

Children under the age of ten years presented 70 cases, forming only 6.0 per cent. of the series.

The average age at operation was 38.0 years for the direct herniæ and 38.5 years for the "direct-indirect."

For the oblique herniæ, the age average was 27.8 years.

The wards of the New York Hospital accommodate both children and adults of the two sexes.

The hospital is centrally situated and draws upon a mixed population, including many foreign born, especially Italians and Russian Jews; its service represents a fairly typical cross-section of the population of New York City.

Although the age at which patients present themselves for operation does not necessarily represent the age at which the hernia originated, nevertheless certain inferences may be drawn from the operative age.

Very few individuals will come to the surgeon at the earliest subjective symptom of a hernia; the majority have been aware of the condition for months or years before seeking relief.

Recently we operated upon a man aged sixty-three years, for a typical congenital hernia, of which he had been conscious for more than 30 years.

## INGUINAL HERNIA IN THE MALE

The routine examination of applicants for insurance, or for civil or military service, brings to light many small herniæ never suspected by the applicant.

The writer inclines towards the hypothesis that nearly all oblique herniæ occur into a potential sac, which sac has been present from birth owing to imperfect closure of the peritoneal funicular process.

However, the mere presence of an open peritoneal process does not constitute a hernia until there occurs invasion of the sac by an abdominal viscus.

In our series the operative age for oblique hernia was 27.8 years.

It would appear, therefore, that even in the presence of a potential hernial sac of congenital origin, the actual development of an oblique hernia in the majority of cases occurs in the third decade.

The years of greatest physical exertion, combining muscle strain and exposure to trauma, serve to force abdominal contents into the peritoneal sac and create a veritable hernia, or by enlarging an incipient hernia render it for the first time obvious to the individual.

A difference of over 10 years between the average operative age for oblique hernia and that for the two forms of direct hernia is significant.

The congenital origin of the sac of oblique herniæ, the recognition of

TABLE IV.  
*Age at Operation.*

	Individuals	Average	Youngest	Oldest	Over 50 yrs.	Over 60 yrs.
Oblique. . . . .	694	27.8 yrs.	6 mo.	70 yrs.	61 cases	9 cases
Direct. . . . .	193	38.0 yrs.	20 yrs.	65 yrs.	28 cases	3 cases
Direct-indirect . . .	52	38.5 yrs.	20 yrs.	65 yrs.	7 cases	1 case

definite hernia at birth or in early childhood, or its development in early manhood, leads to an earlier average age at operation than is the case with the two types of direct hernia.

The earliest definitely direct sac was found in a patient aged twenty years and the average operative age was thirty-eight years.

Hence we conclude that direct herniæ are not due to developmental defect but are acquired later in life.

In our service we have in general followed the rule adopted by the late Dr. W. T. Bull, that herniotomy should be avoided after the age of fifty-five years, unless there are strong indications, such as inefficiency of a truss, inability to wear a truss, strangulation of the hernia, etc.

Among patients over fifty years of age there were performed 70 operations for oblique hernia, showing 2.85 per cent. recurrence.

In the same group there were 49 operations for direct herniæ with 24.4 per cent. recurrence.

In patients over sixty years of age there were 10 operations for oblique hernia with 10 per cent. recurrence; also 7 operations for direct hernia with 42.8 per cent. recurrence.

## MORTALITY

In the series here reported there were 938 individuals operated upon for inguinal hernia, with three deaths, or 0.32 per cent.

The three deaths were the following:

1. CASE 442. C—a man aged forty-seven, of poor physique and arrested pulmonary tuberculosis was operated upon for bilateral direct hernia. Pneumonia developed after operation and he died on the 21st day. Cause of death; pneumonia.

2. CASE 524. M—an Italian laborer aged forty-five years and apparently in excellent condition, died on the 11th day after operation.

The convalescence had been smooth and he was allowed to sit up on the 11th day, when he collapsed and died within a few minutes.



FIGS. 2, 3 and 4.—Illustrating the abnormal "muscle bulge" in the inguinal regions.

The operation had been a Bassini operation for direct hernia (right) with ligation and division of the deep epigastric vessels.

Autopsy revealed a thrombus extending down the epigastric vein to the right femoral vein and that death was due to pulmonary embolism.

3. CASE 567. S—aged fifty-six years, of markedly alcoholic habit and poor physique, had been refused operation by us and discharged from the hospital, but soon returned and insisted on undergoing operation. The operation was for bilateral inguinal hernia. Following operation he developed delirium tremens, tore off his dressings and wound infection set in.

Then ensued a severe, spreading erysipelas which terminated fatally on the 16th post-operative day. Cause of death; wound infection, erysipelas.

## NON-OPERATED CASES

Fifty individuals entered the hospital with the diagnosis of inguinal hernia, but were not operated upon for one of the following reasons: Fifteen changed their minds after admission and refused operation; 35 others were denied operation after careful physical examination.

Among the latter, 8 were well over sixty years of age, and 3 were less than one year old; the remainder were considered poor operative risks by reason of pulmonary, cardiac or renal conditions, diabetes, alcoholism, etc.

## FREQUENCY OF BILATERAL INGUINAL HERNIA

In our series, 222 individuals were operated upon by us for bilateral inguinal hernia, in the group of 849 males; in other words, one in four individuals were operated for bilateral hernia.

Adding those individuals whose history or whose follow-up examinations proved that sooner or later they had bilateral herniæ, we find that 37.4 per cent. of the 849 males eventually had bilateral herniæ.

Our records show a remarkable difference between oblique and direct types of hernia as regards the incidence of bilateral conditions; thus,

Oblique hernia was bilateral in 26 per cent. of the individuals.

Direct hernia was bilateral in 69.5 per cent.

"Direct-indirect" hernia was bilateral in 63.4 per cent.

As just stated, the incidence of bilateral hernia in the entire series of 849 individuals was 37.4 per cent.

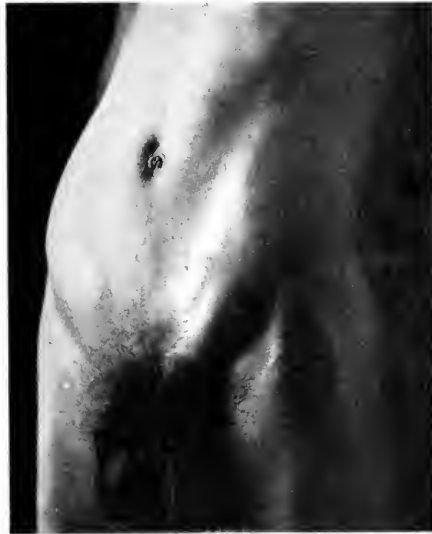


FIG. 5.—Illustrating the bilateral "muscle bulge" shown in standing posture.

## ANATOMICAL OBSERVATIONS

A. *Oblique Inguinal Hernia*.—This type constituted 68.4 per cent. in 1093 operations under consideration.

The oblique sac arises at the internal abdominal ring, being placed between the vas (to its mesial side) and the spermatic vessels (to its outer side) and on a level slightly above these structures.

The sac is often so intimately incorporated with the cord elements because of its inclusion, with them, inside the fascia propria of the cord (*i.e.*, the infundibuliform fascia), that a careful dissection is requisite.

The oblique sac is elongated or funnel-shaped, following the obliquity of the inguinal canal.

Especially in young subjects, it frequently shows constrictions which encroach on the lumen, forming partial or complete partitions between compartments of the sac.

Regarding certain types described in Gray's Anatomy as the "infantile hernia," we have considered this merely as a form of funicular process

hernia; the type described by Gray as "encysted hernia" we have never been able to recognize.

*Treatment.*—High ligation of the oblique sac constitutes the most important step in the operation for cure, and must be attained in every case.

Our practice is to perform the Bassini operation in nearly all cases over twenty years of age.

Under that age, and especially in young children, we often do not transplant the cord after the Bassini method, but rather employ the non-transplantation method of Ferguson, in which the conjoined muscles are sutured to Poupart's ligament in front of the cord.

This latter method seems satisfactory in young individuals whose musculature is good and the hernia small; also it prevents undue elevation of the testicle in the scrotum, which may occur in young children after the Bassini transplantation of the cord.

The true "congenital" sac, communicating with the tunica vaginalis, is best treated by excision of all redundant parts of the sac and turning back of the tunica with suture behind the testis, thus avoiding danger of hydrocele formation which often occurs when a tunica has been reconstructed.

*B. Direct Hernia.*—This type made up 25.8 per cent. of our series, and was shown to be bilateral in 69.5 per cent. of the individuals.

The neck of the sac arises in Hesselbach's triangle, *i.e.*, mesial to the deep epigastric vessels and lateral to the border of the rectus muscle.

The obliterated hypogastric artery subdivides the space into smaller triangles.

In our experience the direct sac usually arises mesial to the obliterated hypogastric, close to the outer border of the rectus.

Frequently, however, the fibrous cord, representing the obliterated artery, is seen coursing upwards over the dome of the direct sac and causing the sac to bulge forwards on both sides of the artery.

According to the anatomists, Gray and Quain, the "conjoined tendon" is stretched across the inner two-thirds of Hesselbach's triangle, passing inwards and downwards to be inserted into the pubic crest and inner part of the iliopectineal line, immediately behind the external abdominal ring, serving to protect what would otherwise be a weak point in the abdominal wall.

Surgically, no such tendon is recognizable in most cases of direct hernia, and the sac seems to present itself below the lowest fibres of the conjoined muscles.

In any event, the surgeon deals with the muscle bellies of the conjoined muscles and not with any thinned-out, problematical "conjoined tendon" when he sutures the muscles to Poupart's ligament.

We believe that the transversalis fascia forms the first and usually recognizable defense of Hesselbach's triangle and that the adequate repair of a direct hernia should include, whenever possible, the separate suture of this thin but important fascia, chiefly because it offers a smooth inner wall to prevent properitoneal fat from insinuating itself between overlying layers.



The direct sac often emerges through a definite split in the fascia or else stretches and bulges the fascia before it.

*Treatment.*—Any operation which fails to provide firm and deep closure of the weak triangle of Hesselbach is not a logical operation for direct hernia.

We believe that the cord should always be transplanted and we do not accept non-transplantation operations as suited to the treatment of direct hernia.

*C. Direct-indirect Hernia ("Saddle-bag Hernia").*—In our traced cases there were 57 operations for this type, composing 5.8 per cent. of the total traced hernia operations.

Anatomically, such herniæ possess a sac which bulges on both sides of the deep epigastric vessels.

Usually the direct bulge forms the larger part of the sac, the oblique bulge being smaller and apparently due to the lateral extension of an originally direct hernial sac.

Rarely there is a typical oblique sac associated with a direct hernia on the same side.

The anatomical weakness which is responsible for this type of sac is so often present on both sides, that we found 63.4 per cent. were bilateral.

In the bilateral group, the sacs were of the same "saddle-bag" type on both sides in more than half of the series; in the remainder there was found a direct sac on the side opposite to the direct-indirect sac.

Both surgically and anatomically the "saddle-bag" hernia must be considered and treated as if it were merely a variation of the direct hernia rather than of the oblique, which conclusion we draw from our experience and for the following reasons:

(a) The age at operation, 38.5 years, is practically the same as the age for direct hernia.

(b) Nearly two-thirds of the herniæ of this type were bilateral, which was also true of the direct herniæ.

(c) When bilateral but of different types on the two sides, we found almost without exception a direct sac on the side opposite to the "saddle-bag" hernia.

(d) The percentage of recurrences was 14 per cent., while that for direct hernia was 17.1 per cent.; whereas that for oblique hernia was only 3.15 per cent.

(e) The problem of muscle repair, namely the firm closure of Hesselbach's triangle, is identical with the problem presented by direct hernia.

*Treatment.*—The direct-indirect sac must be converted into one sac either by pushing to one side (usually laterally) the deep epigastric vessels, or occasionally by ligation and division of those vessels.

The repair of the posterior wall of the inguinal canal should proceed as for direct hernia, and the cord should always be transplanted.

## MIXED TYPES OF INGUINAL HERNIA

In general when inguinal herniæ are bilateral, they will be found of the same type on the two sides.

In our series of 222 individuals with bilateral hernia at operation, 203 were found to have identical types on the two sides.

There were sixteen instances of a direct hernia on one side, associated with a "saddle-bag" hernia on the other side, but we have shown that the direct-indirect hernia is in most cases merely a variety of the direct type.

In only three instances in the series, or 1.35 per cent., was there a definite oblique sac associated with either a direct or a "saddle-bag" sac on the opposite side.

## ASSOCIATED FEMORAL HERNIA

Although relatively infrequent in the male, the possible association of a femoral hernia with an inguinal hernia must be considered in diagnosis and treatment.

There were two cases of a femoral hernia on one side associated with an oblique inguinal hernia on the opposite side.

Also there were three cases of a femoral combined with a direct hernia on the same or on the opposite side.

Among women (55 individuals with inguinal hernia) we encountered four femoral herniæ, or 7.3 per cent., associated with the inguinal hernia.

## SIGNIFICANCE OF WEAK ABDOMINAL MUSCLES

During this study of hernia, Dr. E. H. Pool called attention to the frequency with which we noted a marked bulging of the flat abdominal muscles in the inguinal regions, and we have termed it the "Pool bulge."

In order more easily to demonstrate this bulge, the patient stands with heels together and with head and shoulders thrown backward.

This posture tightens the rectus abdominis and emphasizes the peculiarity, which consists of an oblique bulge, above and parallel with Poupart's ligament and extending outwards from the lateral margin of the rectus towards the crest of the ilium.

In many normal individuals a slight bulging may be seen in this region, but the wide departures from the normal, encountered in some of our cases, will be readily recognized from the accompanying illustrations. (See Figs. 2, 3, 4; 5, 6, 7.)

Usually the bulge is symmetrical and of the same degree on the two sides.

That such a configuration might play a part in the etiology of inguinal hernia, especially of the acquired varieties, or increase the liability to recurrence after operation, led us to look further into the matter.

Careful examinations for this condition were made in fifty consecutive admissions for inguinal hernia in the male, and of these, 80 per cent. showed an abnormal bulge.

Of the oblique hernia cases, 74.2 per cent., and of the direct hernia cases, 92.3 per cent. showed the "Pool bulge."

For control a series of fifty consecutive male admissions, free from inguinal hernia, was similarly examined and 30 per cent. of abnormal muscle bulges were found.

Our examinations therefore showed that the muscle bulge was two and one-half times more frequent in hernia patients than in persons free from hernia.

The average age at examination of the hernia cases was 28.5 years. A marked bulge was found in four cases under ten years of age, the youngest being only four years old.

As regards recurrences of hernia in cases showing the abnormal "bulge," our records show 20 per cent. recurrence for direct hernia, as against 16.6 per cent. for all direct herniæ.

Similarly the oblique recurrences were higher in cases with the bulge, *i.e.*, 5.3 per cent. as contrasted with 3.0 per cent. for all oblique operations.

Thus the recurrences are seen to be above the average, but perhaps less so than might have been expected.

Possible explanation of the bulge may be found in one or more of the following factors:

- (a) Congenital anatomical defect.
- (b) Poor development of otherwise normal muscle.
- (c) Stretching, relaxation or thinning of the muscles from malnutrition, etc., but especially from faulty standing posture which favors visceroptosis.
- (d) Defective innervation.

It seems fair to assume from our observations that such a weak muscle conformation does play an important rôle in the etiology and prognosis of inguinal hernia, especially of the direct types, and the surgeon should hesitate before counselling operation on a direct hernia associated with a pronounced bulge of the muscles.

Recognition of this peculiar muscle bulge must be made when examining patients in the follow-up clinic, lest one mistake it for an incipient recurrence.

There were nine instances in our traced cases where at early return examinations the bulge was regarded as presaging a recurrence, but subsequent and repeated examinations over a period of several years failed to show any recurrence of the hernia.

#### ADMISSIONS FOR RECURRENT INGUINAL HERNIA

There were performed 61 operations for recurrent inguinal hernia in the series of 1093 consecutive operations, or 5.6 per cent.

The recurrence rate in our own 978 traced cases is 7.46 per cent.

It is evident that not all cases which recur are willing to submit to secondary operations, although a certain number of individuals show apparently undaunted confidence in surgery and submit to repeated attempts at a cure.

Two cases in our series were operated for the third time, and two others for the fourth time for one hernia.

The comparison of admissions to a hospital for recurrent hernia, with the total admissions for inguinal hernia over a certain period of time, will always underestimate the actual percentage of recurrence following inguinal hernia repair.

The follow-up clinic of to-day proves this to be so.

Regarding the disposition of the 73 known recurrences in our present series, it may be stated that already 17 cases, or 23.3 per cent., have been reoperated by us; about 10 per cent. have been operated upon at some other hospital; of the remainder, some have declined operation, others present as yet no clear indication for operation, and still others by reason of their age or infirmity have been advised against further operation.

One very great advantage of the follow-up clinic has been the early recognition of incisional herniæ, especially following appendectomy, leading to the early, hence very satisfactory, repair.

#### RESULTS IN FIFTY-TWO OPERATIONS FOR RECURRENT INGUINAL HERNIA

Among 52 traced operations for recurrent inguinal hernia, there are 12 known secondary recurrences, or 23.1 per cent.

TABLE V.  
*Type of Operation Used For Recurrent Hernia.*

	Oblique Operated	Secondary recurrences	Direct Operated	Secondary recurrences
Bassini.....	8	1	11	2
Bassini plus rectus.....	2	0	3	0
Cord not transplanted.....	6	1	1	1
Cord transplant extra-apo- neurotic.....	3	0	14	4
Atypical.....	1	1	3	2
Total.....	20	3 or 15%	Total 32	9 or 28.1%

This table shows the high rate of secondary recurrences after operations for repair of already recurrent hernia.

#### TYPES OF HERNIA FOUND AT RECURRENT OPERATIONS

In five instances the so-called recurrence resulted from a failure to find and eradicate a direct sac at the primary operation.

In every operation for inguinal hernia careful examination should be made on both sides of the deep epigastrics to determine the possible presence of a "saddle-bag" sac, one portion of which may readily be overlooked.

In our 52 traced cases, we have descriptions of the primary operation in 26 instances; the others had been operated upon in other cities or in other lands.

Where the primary operation is known, thirteen were direct sacs at the first operation and all but one of these were found to be direct at the secondary operation; the one exception followed the extra-aponeurotic transplantation of the cord and recurred as an oblique sac issuing forwards through the cord exit at the internal abdominal ring.

The thirteen cases known to be oblique primarily showed nine oblique recurrences and four direct recurrences; the latter type may well have been due to failure to correct a "saddle-bag" sac at the first operation.



FIG. 6.—Case 195. Marked "muscle bulge" persisting after operation for bilateral direct hernia. No recurrence of hernia. Followed for five years.

Including cases not subsequently traced, there were 61 operations for recurrent inguinal hernia.

Oblique sacs were found in 24 instances, and we assume that in all but the one instance just described the primary operation had been for oblique hernia.

Direct sacs were found in 28 cases; direct-indirect sacs in 9 cases; therefore at secondary operation some form of direct hernia was the outstanding feature in 37 individuals.

Of these 37 direct recurrences, we have stated that at least four followed a primary operation described as being for oblique sacs, and it is likely that is true of some others of whom no previous record could be obtained.

We conclude that the vast majority of all herniæ recur in their primary type.

Seven sliding herniæ were found in the series of recurrent herniæ.

#### ACCIDENTS AT OPERATION

The femoral vein was injured with a needle in one case but a lateral ligature was applied and recovery was uneventful.

The small intestine adherent in a sac was opened into, in one instance, and despite the immediate suture of the gut, the wound became infected and the hernia recurred.

The vas deferens was unintentionally divided in six cases, but without demonstrable ill effects later; none of them showed atrophy of the testis nor complained of impotence, pain or other symptoms.

Among the 1093 operations, the bladder was in no instance opened.

#### ADDITIONAL OPERATIONS

1. Appendectomy through the hernia incision was performed in 77 of the earlier cases in this series, but was discontinued as a routine procedure and is only employed when the appendix presents itself readily, because of the danger of hemorrhage or infection due to inadequate exposure.

2. Non-descended testes were found in 20 cases and were treated by the Bevan method without transplantation of the cord.

In following up these cases the testis has usually remained in the upper third of the scrotum, although in three cases it was found well down in normal position.

Within the space of years covered by our follow-up examinations we have failed to note any demonstrable increase in size of the replaced testis; indeed, in over half of the cases (11 cases), the examiner, at a later date, has classed the case as persistent atrophy of the testis.

3. Unilateral orchidectomy was performed in five cases for the following indications:

Case No. 911 had orchidectomy for tuberculosis of the testis and epididymis.

Case No. 729 was a man aged 64 years, with a very large, recurrent direct hernia which was irreducible in the scrotum.

Case No. 983, a man of 62 years with a large incarcerated oblique scrotal hernia.

Cases Nos. 443 and 682, aged respectively 29 and 43 years, each had a very small atrophic nondescended testis, high in the inguinal canal, which could not be brought down into the scrotum.

In every case consent had been obtained before operation.

In Cases Nos. 729 and 983, the problem of a firm repair was found easier after the orchidectomy and both have remained cured up to date, *i.e.*, over three years.

4. Division of the deep epigastric vessels was practiced in 23 cases with wide-mouthed sacs of the direct-indirect type, with the view to converting the double sac into one.

Up to date, five have recurred, or 21 per cent.

Therefore little can be claimed for this procedure, *per se*, unless it contribute to the operator's convenience.

Ordinarily, the vessels may be readily pushed off from the sac, either laterally or mesially, so as to permit of adequate exposure.

One case, No. 524, died of pulmonary embolism following division of the epigastrics, and autopsy revealed a thrombus extending from the stump of the epigastric vein downwards into the femoral.

#### POST-OPERATIVE COURSE

*Duration of Hospital Treatment.*—In uncomplicated cases the stay in the



FIG. 7.—Illustrating "muscle bulge" in the reclining posture, with head lifted.

hospital after operation for oblique hernia averaged 13.7 days, and for direct hernia the average was 15.8 days.

*Wound Infection.*—In the series of 1154 consecutive inguinal hernia operations, male and female, there occurred 55 cases of wound infection, or 4.8 per cent.

This includes even the slightest and most superficial stitch abscess, as well as the 11 more serious infections.

The average hospital stay of these 55 cases was 22.3 days, being approximately one week longer than the normal average.

The 11 deeper infections (0.96 per cent.) were the only cases whose hospital stay exceeded four weeks; but there are already four known recurrences in this group.

The percentage of known recurrences for all grades of infected cases is 10.9 per cent., considerably above the normal rate.

One death, Case No. 567, resulted from erysipelas commencing in an infection of the hernia wound.

#### DELAYED INFECTIONS

There were seven cases where the hernia incision healed per primam but who returned to the hospital dispensary from three to twenty weeks later with a subcutaneous infection, requiring drainage.

The average interval after operation was from four to six weeks, although in one instance the interval was three and one-half months and in another instance five months.

Mechanical or chemical irritation about a non-absorbed suture with a latent, low-grade infection, was accepted as the explanation; particularly about the deep sutures of kangaroo tendon.

Since January, 1920, linen thread has been used as a substitute for kangaroo tendon, but already we have seen several cases of delayed infections about a linen suture.

#### POST-OPERATIVE SCROTAL TUMEFACCTIONS

In an earlier communication based upon a study of 148 inguinal hernia operations, occurring in the first and second year of the present five-year series, I stated that "the bedside notes revealed 56 cases of demonstrable adventitious swellings in the scrotum, almost immediately after operation, an incidence of 37.9 per cent. These swellings were much more frequent after operation for oblique hernia, *i.e.*, 48 per cent.; whereas after direct hernia there were 15.2 per cent."

"There were found 20 early hydroceles of the tunica vaginalis among the 56 tumefactions in the 148 hernia operations."

At that time an attempt was made to classify the swellings and to explain the etiology.

It was further stated that "many of the tumefactions are of little more than academic interest—and in less than three months more than half of them have entirely disappeared."

A plea was made for the utmost gentleness in dissection and the least possible handling of the cord.

In our present study, based upon the post-operative notes on 1093 male hernia operations, we noted 144 scrotal tumefactions, or 13.1 per cent.

There were 51 (or 4.66 per cent.) early hydroceles, demonstrated by aspiration, which yielded on the average from 20 to 60 c.c. of clear yellowish serum.

These figures are much more conservative than those of the earlier report, perhaps due to less thorough examination and notations during the exigencies of the World War period, but certainly in part attributable to more



careful technic at operation and by abandoning the practice of reconstructing a tunica in cases of congenital hernia.

Of the 51 post-operative hydroceles, 9 could not be traced, leaving 42 cases which have been followed and whose course ran as follows:

- (a) Disappeared within four months, 15 cases.
- (b) Disappeared between four and twelve months, 17 cases.
- (c) Persisting over one year, 10 cases.

The hydroceles when first noted, in from one to three days after operation, were usually small collections of fluid which might easily be overlooked on casual examination.

Early aspiration was practised on over 80 per cent. of our cases and repeated several times if indicated, which treatment may explain the disappearance in many cases.

The ten cases which have persisted more than a year bid fair to become permanent, unless operated upon, as three have already been.

In addition to the definite hydroceles, there were 93 other post-operative tumefactions, which we have attempted to classify as distention of veins above the testis; thrombosed veins; thickening of the tunica, after excision and turning back of the same; hæmatomata; epididymo-orchitis, as evidenced by swelling and induration of the testis and epididymis, probably from œdema.

More than half of these swellings disappeared completely within three months, others persisted as small fibrous irregularities along the cord or about the testis.

Of greatest importance is the fact that nine of the cases classed either as hæmatoma or epididymo-orchitis subsequently showed atrophy of the testis after disappearance of the primary swelling.

Very few scrotal swellings occurred in direct herniæ.

## PERSISTENT PAIN

Among the 978 traced cases there were 11 cases who complained of pain in the groin or scrotum over periods of from three months up to two and one-half years.

One case had a large varicocele, not operated, a possible factor in the etiology of the pain.

Two cases had developed post-operative epididymo-orchitis.

Two cases had a recurrence of the hernia.

One case had had a large scrotal hæmatoma, which had required drainage.

In the five remaining cases, no explanation for the pain is offered, either by the findings at operation or the early post-operative course, but probably represent some form of nerve involvement.

## ATROPHY OF THE TESTIS

There were found 15 cases of post-operative atrophy of the testis, not counting 10 cases of non-descended testis, where atrophy of the replaced testis continued as before operation.

Nine cases out of the fifteen, developed atrophy of the testis after an early post-operative swelling, especially epididymo-orchitis. Four others occurred after difficult operations for recurrent scrotal herniæ, requiring much dissection and handling of the cord. The two remaining cases are not explained by the records.

1. The usual Bassini operation with transplantation of the cord beneath the aponeurosis was used in 717 cases and yielded 7.33 per cent. of recurrences.

TABLE VI.  
*Results From Different Types of Operation in 978 Traced Cases.*

Type of Operation.	Oblique Hernia		Direct Hernia	
	Operations	Recurrences	Operations	Recurrences
1. Bassini.....	532	17 or 3.2%	185	29 or 15.67%
2. Bassini with rectus.....	13	0	35	4 or 11.4%
3. Cord not transplanted.....	112	3 or 2.67%	25	7 or 28.0%
4. Extra-aponeurotic transplant of cord.....	8	1 or 12.5%	64	10 or 15.62%
5. Atypical repair.....	0	0	4	2 or 50.0%
Total.....	665	21 or 3.0%	313	52 or 16.61%

It is perhaps the best single operation for all the different types of inguinal hernia if one had to be limited to any single operation; but for children under the age of fifteen years, non-transplantation of the cord as recommended by Ferguson is better suited and less injurious for reasons we have already stated.

For direct hernia, the Bassini operation yielded 15.67 per cent. recurrences, which result is far from ideal and urges one to seek for some operative procedure which will prove more satisfactory.

2. Bassini with rectus. This modification of the Bassini operation by which the edge of the rectus muscle, or a portion of its sheath, is brought down and sutured to Poupart's ligament, was used in 48 cases with somewhat better results than in the simple Bassini.

3. Non-transplantation of the cord, as in the Ferguson and in the Johns Hopkins operations, is well suited to the treatment of oblique hernia in the young; but we believe that it is not the logical method of repair for direct hernia.

In 25 cases of direct hernia thus treated by us, we had 28.0 per cent. recurrences.

In the Johns Hopkins series, where non-transplantation operation was presumably employed, there were reported 29.7 per cent. recurrences among the total of 47 direct hernia cases which were submitted to reëxamination at that hospital.

4. Extra-aponeurotic transplantation of the cord, in reality a modification of the original Halsted operation, was used in 72 instances in our series of

978 traced cases, chiefly for direct hernia (64 cases). The recurrence rate after this operation in direct hernia was 15.62 per cent., being practically the same as after the Bassini.

At first glance, these figures appeared disheartening, when one considers that this procedure was undertaken in the effort to improve results.

It must be stated, however, that the cases selected for this type of operation were, almost without exception, cases in which the problem of a successful repair promised to be a difficult one; thus, in five instances the sacs were extremely large and of long duration; in 16 cases the hernia had already recurred one or more times; in 22 cases the age was over fifty years and the age average for this group was forty-two years.

Objections have been voiced to this method of extra-aponeurotic transplantation, on the grounds that the superficial position of the cord might unduly expose it to trauma, or be painful.

In only two of our 72 cases was persistent pain complained of, and in each of these cases the operation was for a recurrent hernia.

One case showed atrophy of the testis; this also was an already recurrent hernia.

Only one of the recurrences after this type of procedure occurred at the site of the internal abdominal ring; all others recurred as direct herniæ.

At present we employ this method for the more difficult of the direct herniæ and whenever the muscles are markedly deficient.

## IMPROVED TECHNIC FOR GASTRECTOMY AND GASTRO-ENTEROSTOMY

BY LEONARD FREEMAN, M.D.

OF DENVER, COLO.

IN surgical operations it is important to develop a technic that will produce the best results in the simplest manner. With this object in view, I venture to suggest a method of performing gastrectomy, gastro-enterostomy and other similar operations which has proved to be unusually easy and effective in the instances in which I have employed it.

The objections to the ordinary methods are quite evident. For instance, rubber-covered forceps used singly, or combined into a rather expensive and cumbersome three-bladed instrument, may crush the mucous membrane, thus leading to hemorrhage or ulceration, as emphasized by Coffey and others. Some surgeons have even given up their use on this account. Also, under certain conditions, the broad blades of the forceps may occupy too much valuable space, and it is then, especially, in one's desire to prevent slipping, which cannot always be done, one may clasp the instrument with damaging tightness. This applies particularly to high resections of the stomach, to the unloosening of old gastro-enterostomies and to Finney's pyloroplasty.

Certain specially devised clamps tend to obviate some of these difficulties, but not all of them, and in addition these clamps have disadvantages of their own.

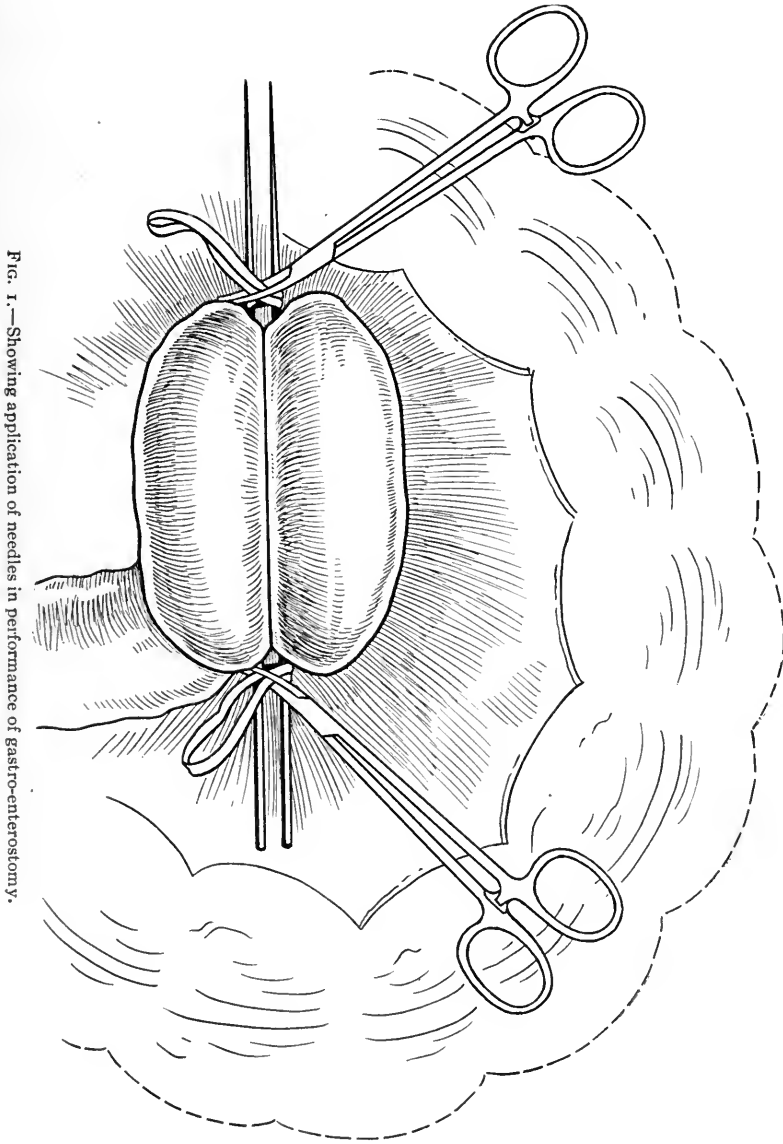
The use of the suture alone may be quite satisfactory in experienced hands, but it requires much practice and technical skill. The average surgeon is apt to approach it with hesitation, because of the absence of hæmostasis and the possibility of soiling the field of operation.

*Operative Technic.*—The special equipment consists of two mattress needles, a foot or so in length (long needles used in the manufacture of mattresses and to be obtained in most hardware stores). Also four Allis-forceps and several ordinary rubber bands about one-eighth inch in width.

*In gastro-enterostomy*, after exposure of the stomach and jejunum, a fold is picked up from each with the Allis-forceps and brought alongside of each other in the position in which they are to be united (Fig. 1). A mattress needle is then placed well down on either side of these folds, pressing them closely together into two prominent opposed pouches, such as are formed when forceps are used (Fig. 1). While the needles are held in place by an assistant, a rubber band is wound around their ends upon either side, tightly enough to bring the elasticity of the bands into play, and clamped with forceps (Figs. 1 and 2). The operation is then completed in the usual manner.

The advantages of this procedure are several:

Its simplicity and ease of performance.



The impossibility of injury to the mucous membrane, owing to the mildness of the elastic pressure and its uniformity, depending upon the fact that the needles, unlike forceps, are everywhere parallel to each other.

The small amount of room occupied by the needles as contrasted with forceps, which may be of great importance.

The unlikelihood of slipping, because the small diameter of the needles permits them to sink slightly into the soft tissues. If, however, in an excep-

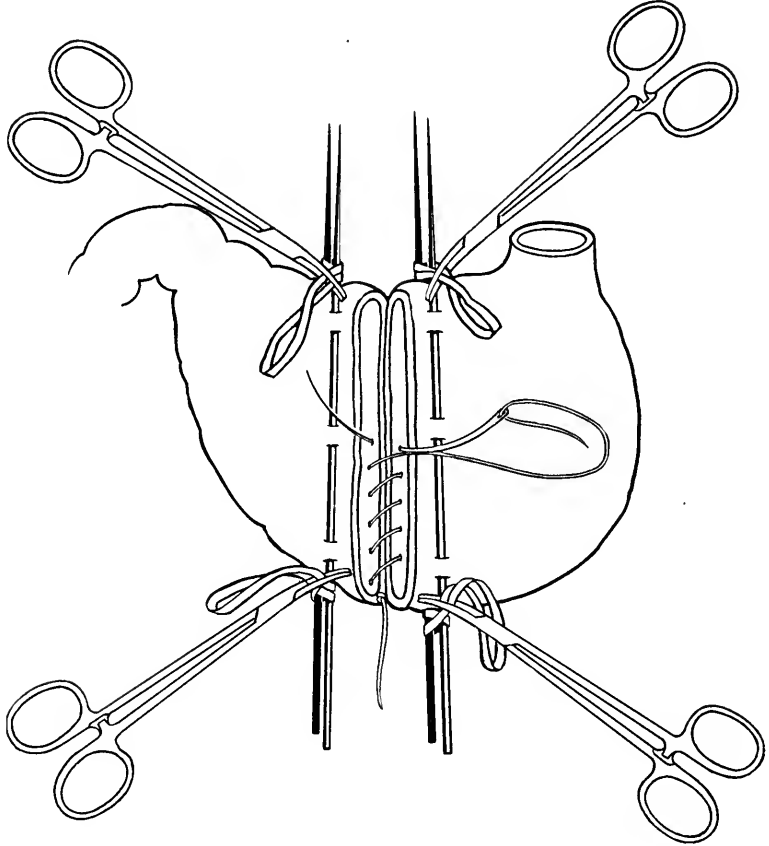


FIG. 2.—Showing method of application in gastrectomy.

tional instance, slipping is feared, one or both of the needles may be made to catch up a little of the peritoneum in one or more places, which will insure their retaining their positions (Fig. 2).

And lastly, the fact that the pouches are pressed firmly together, without the intervention of forceps, which not only facilitates suturing, but also does away with the necessity of placing gauze between the intestinal loops to prevent soiling.

*In gastrectomy*, the advantages are marked, especially when a high division of the stomach is called for. After freeing the organ, a mattress needle is

placed on either side, above the proposed line of section. In order to obviate the danger of slipping, so common with rubber-covered forceps, the needles are stuck in and out at several points, through the external coats of the stomach, without penetrating its lumen. Care is taken that one of these points is near the upper and one near the lower border in order to hold the gastric arteries with certainty (Fig. 2). The rubber bands are then applied as already described.

It is obvious that the stomach and its vessels will now be firmly held and closed, without danger of slipping or of injury to the mucosa, and with the sacrifice of a minimum amount of room, which perhaps is not the least of the advantages. Crushing clamps will of course prevent slipping; but, in addition to occupying valuable space, it is questionable whether the severe injury to the tissues is not detrimental to smooth healing.

Other uses of this method in connection with operations about the stomach will suggest themselves; for instance, in Finney's pyloroplasty, where forceps are too large and clumsy to be used easily and are apt to slip, a fold from the stomach and one from the duodenum can be elevated with Allis-forceps and clamped together so as to include the pyloric region, running the needles through the subperitoneal tissues at a few points when this seems necessary. Likewise, in operations for restoration of the *status quo ante* in poorly-functioning gastro-enterostomies, it is quite easy to handle the stomach with needles where it would be difficult with sutures alone, owing to the likelihood of spilling the gastric contents; or with rubber-covered forceps, because they occupy too much room and are too liable to glide from the comparatively small stomach-fold with which one is often compelled to work under very unfavorable conditions. Shorter needles, obtained by cutting off portions of the longer ones, may occasionally be desirable.

# THE LIMITATIONS OF THE OCHSNER TREATMENT IN CERTAIN CASES OF SUPPURATIVE PERITONITIS\*

BY JOHN H. JOPSON, M.D.

AND

DAMON B. PFEIFFER, M.D.

OF PHILADELPHIA

IT is impossible to discuss the limitations of the Ochsner treatment of appendicitis and peritonitis at the present time, without first reviewing the attitude of the surgical profession to that method. The omission of such a review would lead to the erroneous impression that we assume that it had been generally accepted by the profession at large. It is now many years since its distinguished advocate, whose name it bears, first presented it to the attention of the surgical world, and during that time the pendulum of opinion as to its place and value has not ceased to swing toward and away from its more general adoption. It was advocated as a method of physiological pre-operative treatment of a condition in which operation was universally attended by a high mortality. It yielded, in the hands of its originator, and of many of his followers, results that seemed to them vastly superior to those achieved by other and more precipitate methods of treatment, methods which were characterized by immediate or early operative intervention. It has, however, never commanded anything like universal attention, and it seems to us from a review of the literature of the last six years, that it is perhaps less popular to-day than when we last reviewed this subject in 1916. Our opinion as to the present attitude toward the Ochsner treatment is based partly on a study of the literature of this country, and of Europe, and partly on personal observations and communications.

As we have remarked before, it might properly be spoken of as an American method of treatment of peritonitis, and this, not because of its universal adoption in this country, but because it has won scanty recognition abroad. Personally we have long been convinced of its value as a substitute for immediate operation in certain cases of acute diffuse peritonitis, a conviction based in part on personal experience and observation, and in part on the study of reports of large series of cases treated by this and other methods. While nothing has shaken our faith in it as a general principle of treatment, we realize, from the published reports from clinics, large and small, in this country and abroad, that it has not the place in surgical favor which one would have expected to find after a favorable experience with it.

An analysis of statistics from many sources would indicate that the general mortality from acute appendicitis has been lowered within the last few years. The general recognition of the value and safety of immediate operation in the

---

\* Read before the American Surgical Association, May 2, 1922.



early hours of an acute attack, and the emphasis laid by teachers on the necessity of early recognition, has, in this country at least, reached almost a generation of medical students. To-day there is a unanimity of opinion in America at least, as to the necessity of immediate intervention in this group. It is also true that this opinion is not of universal adoption in some European countries, notably in France, where we find the surgeons divided into interventionists, abstentionists and opportunists, which are strangely unfamiliar names to us.

When we come to study the attitude of surgeons everywhere toward the treatment of an acute and established peritonitis, we find some authority for almost every conceivable method of treatment, and time of intervention. There is no consensus of opinion as to the choice between immediate intervention and delay with pre-operative treatment. We have been able to classify to a certain extent the opinions as to the method of choice into the following rather imperfectly defined groups.

1. The first group would include those surgeons who are in full accord or close agreement with a waiting policy in all cases of peritoneal infection after the first two days. The time limit we have mentioned, but we believe it an unfortunate practice to measure sharply the progress of intra-abdominal pathology in terms of hours. The element of time is a feature of the anamnesis which must be carefully considered. It must, however, be correlated with the symptoms and the balance struck in terms of probable and not absolute truth as an index of pathology and a guide to treatment. Otherwise grave mistakes will be inevitable. While the names in this list are very weighty in authority, their number seems surprisingly small.

2 This group includes a list of authorities, many foreign, who consider delay advisable under certain circumstances, but we find among them a diversity of conflicting opinions as to the time of operative intervention, but a practical unanimity of disagreement with or disregard of the teachings of the first group. By them operation is rather reserved for the exact class of cases in which we have been accustomed to avoid it, viz., those in which the symptoms, local and general, are unfavorable or very grave. Abstention from operative interference in acute appendicitis when emphasized seems to us to miss the point entirely, that is operation when it can be practiced most favorably, and before peritonitis develops. At this stage experience teaches us that the mortality is almost negligible. Extremely long delay is counselled in cases of abscesses of some standing in the hope of further absorption or of rupture into the bowel. Large collections alone are considered favorable for the operation. This list is a long one, and contains many of the best known names in French surgery

3. A large group with many leading American surgeons among its adherents. Here we find no mention of the Ochsner method or its equivalent. Advice is against delay under any circumstances or on any grounds except in the moribund. In this group are many adherents, who, if they practice what they teach, lose no time after making a diagnosis, but operate at once.

If we attempt the difficult task of weighing the evidence in favor of one or the other of these methods of treatment, as advocated by the different groups, it leads us into a maze of statistics. These share the common features of a rather low combined mortality for appendicitis cases in general. Analyzed with respect to the mortality of operation for acute diffuse septic peritonitis, they show a range of mortality in what might be styled the intermediate stage, of from 17 per cent. to 65 per cent. in most series. Now and again we find a record of some very large series of undifferentiated cases with a mortality almost nil. When such a series is credited to one or two individuals in a clinic, one may be pardoned for wondering to what assistant is assigned the desperate risks, and what his feelings and mortality may be.

That there is still a considerable number of cases which reach the surgeon when in desperate condition there can be no dispute, at least such has been our experience. It would seem as if we had reached the limit in this direction of the education of the medical profession. But we still encounter too frequently the case that has been purged on one ground or another, or on general principles. A procrastinating policy, with desire to avoid the unpleasant responsibility of urging operation or surgical consultation explains many other cases. Honest mistakes in diagnosis in the hands of careful surgeons and experienced practitioners contribute a small but ever present percentage here as elsewhere. Where the majority of cases are referred by members of a staff in close touch with its activities, the number of late cases is small. Where the contrary holds true it is larger.

We would reiterate our adherence to the general principles of the Ochsner treatment. There are certain limitations, not sufficiently emphasized, which have been impressed upon our minds by personal experiences.

Generally speaking, in young children it is difficult to carry it out in its entirety, and sometimes unsafe. Starvation means an early onset of acidosis aside from that dependent upon sepsis. The vital resistance of tissues including the peritoneum to the encroachment of sepsis is much less. Witness the quiet but rapid progress of a peritonitis in the earliest stages of a suppurative appendicitis at this age. The danger of metastatic infection in remote regions, as the subphrenic space, the lungs and elsewhere, is greater. In the doubtful cases at this age we incline to immediate operation in all except the moribund.

A strong indication for immediate intervention is met with in cases in which the question arises as to origin of the peritonitis, and the diagnosis is confused between that of appendiceal origin, and peritoneal irritation or infection from perforative lesions of the gastro-intestinal tract of other types. There are cases of pyloric ulcer especially in which the history of pre-existing gastric or other disturbance is unobtainable at the time of surgical consultation. All surgeons have encountered cases of this type and have operated at times on a mistaken diagnosis of appendicitis. If a rigid policy of abstention is pursued in the face of a lingering doubt, added fatalities will result.

A very important group, and one little touched upon, we have encountered several times of late. These are cases of acute free perforation of a pre-existing appendiceal abscess, giving rise to a violent peritonitis. The following case histories will illustrate the salient features in this class:

N. D. W., age thirty-one, had suffered for years with so-called bilious attacks. Present illness began with abdominal pain and vomiting. For two days was not confined to bed, suffered intermittent pain, and dosed himself with rhubarb and soda. Pain returned with great severity the evening of the day we saw him. When first seen at about 9 P.M. he was suffering excruciating abdominal pain. His abdomen was very rigid throughout. There was an entire absence of peristalsis on auscultation. Pulse 80 and of good volume, temperature  $100^{\circ}\frac{1}{2}$ , leucocytes 8400. He was sent to the Bryn Mawr Hospital, and placed upon the Ochsner treatment. There was marked improvement for 36 hours. Leucocytes rose to 13,000. The abdomen became softer, a mass formed in the right iliac region, there was some return of peristalsis, the pulse was good, at times irregular (he had long had an arrhythmia) and he was in general rather comfortable. On the evening of the second day he was not so well. He had vomited a bilious material, there was no action of the bowels, and it was thought best to operate. Section revealed a very extensive peritonitis in the lower abdomen and pelvis. The appendix had sloughed off at its base, and fecal matter was escaping from the opening in the cæcum. The small intestine was still distended and paralyzed. There was a foul collection around the cæcum, and the pelvis was the site of a large collection of yellow pus, which we took to be an abscess of older date than that associated with the diffuse peritonitis at a higher level. A drainage operation was performed with difficulty, and reaction followed in this desperate case. For two weeks he made a determined fight against peritoneal sepsis and intestinal obstruction. Enterostomy was done later with temporary relief, but the patient succumbed suddenly to cardiac paralysis, while still exhibiting symptoms of the above mentioned complications.

In this case we believe it would have been better to have operated immediately. While it might seem, *a priori*, that a peritoneum capable of localizing an acute infective process in the first instance, should be able to repeat the performance, yet we believe that rupture of an abscess is an exceedingly fatal occurrence, a second localization rarely taking place.

An insufficient amount of attention has been paid to this accident. It is rarely observed in cases under rigid hospital regimen. If operation be not too long delayed under such conditions it almost never occurs. General sepsis may supervene from unreasonable delay. Obstruction is seen more frequently and subphrenic abscess may develop and make the most astonishing progress if not recognized. But rupture if it occurs in such cases usually takes place by perforation into the bowel. But in all acute cases admitted during the stage of acute peritonitis, the possibility of rupture of an abscess into the general peritoneum must be remembered. There is usually the history of an attack of several days' duration, although here again we must avoid the mistake of measuring pathology solely by time. With this there is commonly the history of sudden exacerbation of acute abdominal symptoms, especially pain. Shock is a frequent and striking symptom, with circulatory failure, amounting at

times to collapse. The abdominal rigidity increases and may become as board-like as that seen in perforated pyloric ulcer. The leucocyte count is sometimes extraordinarily low. All these symptoms point toward an acute abdominal invasion inconsistent with the presence of a diffuse peritonitis of slow extension and long duration. Under such circumstances we believe the urgent indication is for operation at once.

Even a delay of a few hours is likely to prove fatal in this complication, owing to the extensive contamination of the peritoneum.

F. C. L., age forty-five, treated by physician for several days as a case of enteritis, or abdominal gripe. Had been allowed up, when he was taken very ill in the morning while at stool, with severe pain, accompanied by collapse. When seen at the Presbyterian Hospital that afternoon, he exhibited the signs of a general peritonitis. His condition was not good, his pulse 120, the abdomen characteristic. Leucocytes 6400. It was deemed wise to operate at once. When opened the abdomen showed a diffuse general peritonitis, and an abscess in the pelvis, of older date, which had recently ruptured into the general peritoneum. It owed its origin to a gangrenous appendix. Appendectomy and drainage were performed. There was scarcely temporary improvement, and the patient died on the third day after the operation of septic peritonitis.

The following case recovered with immediate operation:

Dorothy D., age two years, eleven months. Sick three days with a diagnosis of appendicitis. Had not been seen by a surgeon. The history had been quite typical but her physician was striving to avoid operation. She had pain off and on throughout the attack, but the night preceding the day on which we saw her, which was the third day of her illness, it had been more severe. On that day also she vomited for the first time. There was no marked change in her condition, however, until early in the afternoon of the third day, when she went into a condition of shock. When seen by us three hours later, she had reacted from the collapse which had alarmed her physician and family, and presented the usual evidences of appendicitis, with what was evidently a diffuse peritonitis. The rigidity and tenderness were not extreme. Her general condition was fair, and her temperature elevated. She was removed to the Bryn Mawr Hospital and operated on the same evening. Temperature on admission  $103\frac{3}{4}$ , pulse 140. On opening the abdomen a thick-walled and well defined abscess was discovered, around a rather high perforated appendix; the abscess had undergone recent and spontaneous rupture. Retraction without the slightest disturbance of the relations showed a thin stream of pus trickling down into the comparatively clean peritoneal cavity. There was not the slightest doubt in our minds that the collapse which had been noted in the afternoon, and which may have been preceded by some exertion, had marked the first involvement, or rather reinvolverment of a peritoneum which had once successfully combated the infection, but which could hardly be trusted to do so again. Appendectomy and drainage were followed by a very smooth and prompt recovery.

It is true that operation in this stage will yield a considerable number of fatalities. It is unlikely, however, that a peritoneum that has once successfully resisted the gradual or free rupture of a suppurating appendix can again combat such flooding with pus of frank and highly virulent nature.

Again, there are other types of appendicitis in which the onset of peritonitis may be attended by and due to a volume of infection similar to that seen in acute intestinal perforation of traumatic origin, or even a ruptured abscess. Two such types are the rupture of a large appendix, distended with pus, or the perforation, near its base, of a patulous appendix, which permits free leakage of fecal matter into a peritoneum not shut off by pre-existing adhesions. Such accidents may be delayed long beyond the 48-hour time limit arbitrarily fixed for the period of immediate intervention. Delayed pathology is the explanation, and in the presence of such a picture of acute abdominal catastrophe, the necessity of immediate operation needs no argument for its support.

Finally, it is well to remember that a too rigid adherence to any rule of practice may be followed by regrettable mistakes. Dogmatic and sweeping statements are perfectly justified in teaching immature student minds which must first grasp the main principles. Many of the authorities we have studied have changed their views so radically that one may be pardoned for wondering whether they must not sometimes regret their former unreconcilable attitudes.

Judgment is developed by experience, and while we cannot always explain the mental processes by which the masters in surgery arrive at quick and correct decision, we must admit that it is by reason of such ability that they are masters.

Any one who believes that the treatment of appendicitis has been standardized even in its main essentials should review the literature of the last few years. It is no longer voluminous, and except for a recent flurry before the Society of Medicine in Paris, not even controversial. It would seem that different clinics and different geographical localities have settled down to established practices with which they are content, though those practices are often diametrically opposed to those in vogue in other clinics of equal standing. There is general agreement on only one point, namely, that the management of this disease should be delegated to the surgeon.

However, when the patient reaches the surgeon he may find himself in the hands of what the French call an "interventionist" who will operate upon him at once, regardless of the stage of the disease or his general or local condition. Or especially if he be in France, Switzerland or parts of Germany, he may find his surgeon an "abstentionist" who will not operate in the acute stage unless after a period of observation it is evident that the patient has failed to improve or perhaps is worse. Again using the handy French division, the surgeon may be an "opportunist" who will operate at once if the attack has lasted no more than 36 to 48 hours, but after that will wait for conditions to improve or even resolve entirely before risking operative intervention. This is the old strife for the interval operation, and such names as Jalaguier, Tuffier and Walther are still connected with it. Témoin of Bourges has recently launched a most determined attack upon this plan and heads the "interventionists" in France. As yet they are in the minority. In England, during the last six years, no one has raised his voice for delay in

operation upon any type of case. In America, our patient probably would be subjected to immediate operation regardless of the stage of the disease or his condition, but there is a fair chance that he might enter a clinic whose policy it is to treat certain cases of appendicular peritonitis by the well known principles of anatomic and physiologic rest, hoping for localization before operation. It is impossible to secure pure and homogeneous statistics to settle the relative superiority of these various plans. Low mortalities are claimed for each by their respective adherents.

It seems clear that the usual case of early appendicular peritonitis should be operated upon without delay with the reasonable expectation that the peritoneum will take care of the infection already liberated. It seems equally clear that the same group of cases, properly and rigidly treated by anatomic and physiologic rest, can in the vast majority of instances be brought to subsidence or localization, conditions which permit operation with very low mortality. Failures will occur in each group, but if we can judge by reported results the mortality figures will not differ greatly. Now we know that by far the greater part of the mortality from appendicitis comes from the group which exhibits when first seen a widespread peritonitis with evidences of profound systemic toxæmia, and usually in the third or later days of the disease. Leaving aside the question of elimination of this type of case by more timely recognition, it is evident that the reduction of surgical mortality must deal chiefly with this group. Those who have made use of Ochsner's plan cannot fail to have been impressed with the general improvement and localization of the peritoneal process that may occur in seemingly desperate cases. Nor can they have failed to note that other cases exhibit no such tendency but proceed to generalization and death. On the other hand, those who practice immediate operation must often have had the experience that the post-operative condition of the patient is obviously worse than before operation, and death results from progressive toxæmia, within a few hours or days. It does not seem likely that the deaths in both groups affect the same individuals under such different forms of treatment. Can we not further define our indications for and against immediate operation? Are there not cases undergoing localization or capable of localization which yet present the signs of widespread peritoneal irritation and marked general toxæmia? We believe there are and that precipitate operations in this group will often determine a fatality, when rational pre-operative measures will bring safety. On the other hand, there are certainly cases that show no tendency towards localization and will inevitably perish under any waiting policy. In the body of this paper we have made a plea for recognition of certain types which are likely to fall into this group, notably: (1) Young children, (2) cases of delayed and fulminating gangrene or perforation and (3) intra-abdominal rupture of a localizing or localized abscess. Such conditions can at times be reasonably surmised from the history and clinical conditions, and such evidence should take precedence over inflexible rules based upon ideas of a pathology which does not always run true to form.

The following brief summary of the literature of the last five years is appended to show the extraordinary variety of views still maintained in regard to this question which many of us have come to regard as trite and practically standardized:

A. J. OCHSNER reiterates his belief in the plan formulated in 1892 and carried out by him ever since. The cases in which delay is practiced are not clearly defined, but in general it is implied that cases of beginning diffuse peritonitis of over 48 hours duration, are so treated. In previous publications, however, Ochsner has indicated clearly his views and treatment.

JOHN B. DEEVER says, "in progressive peritonitis, usually of more than 40 hours, it is safe to presage a fatal outcome if operation be undertaken in the presence of symptoms of diffusing peritonitis—rapid running pulse, abdominal distention, cyanosis of the *facies Hippocratica*—while delay may save the patient in such cases."

EUNICKE recommends delay in operation upon diffuse peritonitis, gastric lavage for vomiting, warmth to the abdomen, saline solution by bowel and camphor hypodermatically. Operation is to be undertaken when improvement occurs.

SEHRT advises delay in cases which show in the fifth to the tenth day the outspoken picture of peritonitis, associated with prostration, rapid pulse, often vomiting and a large area of dulness in the right iliac fossa. His "conservative therapy" consists of a few teaspoonfuls of cold tea, cold red wine and frequent mouth washes with cold water, moist applications on the abdomen, no opium. He does not operate unless the general condition is good, even waiting in some cases of localized abscess for spontaneous rupture into the intestine.

LÖFFLER (Hochenegg's Clinic), in a highly statistical paper, reports 463 cases, of which 406 were operated. Very mild cases were treated without operation, and all were cured or relieved. Several of these were operated upon because their symptoms were progressive. Any sign of peritonitis was an absolute indication for immediate operation.

BEVAN states that immediate operation is best in all cases; but those which cannot be given the benefit of early surgical treatment; in doubtful cases; and in advanced age or serious organic contraindications. These cryptic rules are not elaborated, but he further says, "I now operate at once, regardless of the day of admission." It seems a fair inference from the exceptions that Bevan has in mind a group of cases in which a period of delay is advisable before operation.

PAUCHET (Amiens) advises early operation in all cases except in mild cases of several days' duration when medical treatment is permissible; in cases showing marked symptoms and serious outlook, operate if within 48 hours of onset; in abscess formation, wait for an opportune moment; in generalized peritonitis, he says, "I believe that if it were possible to secure comparable statistics on these cases operated upon by different surgeons, or left to themselves, the mortality would be almost the same, with or without intervention." He believes "the average surgeon will get the best results by letting them alone."

HARTMANN (Paris) advocates immediate operation in all cases except abscesses (which he treats expectantly), and in the face of a serious general condition of the patient.

JALAGUIER (Paris) prefers to wait for the interval, if symptoms are mild. "In the immense majority of cases of ordinary and easily recognizable types, rigorous expectant treatment should be instituted. In a few hours one is settled." If symptoms persist or increase, operate at once. Otherwise wait. Hospital management under the surgeon's care is imperative, as urgent symptoms may arise at any moment and demand immediate intervention. If the patient is in a state

of collapse when seen, stimulate and wait a few hours before operation. He claims 3 to 4 per cent. mortality in acute cases, and admits that he operates more freely than formerly. (Note that this plan is in many respects the reverse of Ochsner's treatment. The more serious the condition, the more urgent the operation, except in the case of collapse.) No statistics are given.

TUFFIER (Paris) states that he was formerly a partisan convinced, and a defender of the immediate operation in all cases, but that he has little by little retreated from this position, and his practice is identical with that of Jalaguier.

QUÉNU shares the views of Jalaguier and Tuffier, but he says he operates in some cases in the acute stage.

GOSSET, BERGER and LENORMANT agree substantially with Jalaguier.

WALTHER operates immediately, if seen within 48 hours. After this time, if the case is improved, he delays; otherwise operates. He prefers to treat appendicular abscesses expectantly, awaiting absorption or spontaneous rupture into the bowel. He reports 700 cases, mortality 3.85 per cent. In the period 1913-1919, 162 cases; 2 deaths; 1.23 per cent.

BAZY advocates in typical, advanced, general peritonitis, multiple incisions and drainage under local anæsthesia. Of 35 cases, 24 died; 68 per cent. Of the 24 deaths, eleven died within 24 hours. He defines a group suffering from marked toxæmia and extensive peritonitis in which he prefers to await localization. In general, he holds with Témoign, that intervention should be the rule, and waiting the exception.

ALEXANDER reports cases of acute appendicitis in children with 15 deaths; mortality 3 per cent. He states that the only type of acute appendicitis with diffuse peritonitis in which delayed operation is advisable and justifiable, is when the patient is seen after 2, 3 or 4 days of illness, and presents vomiting, general abdominal tenderness, absence of peristalsis, marked abdominal distention, slight cyanosis with rapid pulse and dry coated tongue.

REHN advises immediate operation on all cases, as soon as diagnosis is made, regardless of stage, extent or localization.

EICHHOFF employs Rehn's method; reports 69 abscesses operated, with 3 deaths, 4.4 per cent., 47 cases of free purulent exudate (peritonitis) with 9 deaths, 19 per cent. Only one of these deaths occurred in cases operated upon in the first 24 hours. The series is not so analyzed as to demonstrate the effect of immediate operation in the *late* cases of diffuse peritonitis. The mortality is almost limited to this group.

JENCKEL gives no consideration to delay in cases of diffuse peritonitis. Of 830 cases, 31 died, 3.7 per cent.; 62 of these showed diffuse peritonitis, 22 died, 35.4 per cent.; 46 of the latter are analyzed with reference to stage, as follows:

20 operated upon within 24 hours .....	1 died
12 operated upon within 48 hours .....	4 died
13 operated upon within third day .....	13 died
1 operated upon on seventh day .....	1 died

It is evident that the late cases could not have fared worse if operation had been postponed.

HUGHES summarizes essentials of operative treatment of diffuse peritonitis without reference to the principles of the Ochsner treatment.



## OCHSNER TREATMENT IN PERITONITIS

CRILE reports 407 consecutive operations for acute appendicitis by Lower and himself, without a death. This is a brief article enunciating Crile's principles of treatment, and makes no mention of Ochsner's treatment. Unfortunately, no statement is made concerning the disposition of cases of late and wide-spread peritonitis.

LAROCQUE justifies delay only in order to get patient to competent surgeon and proper surroundings; or to enable a more thorough operation when a combination of pathology is present. No mention is made of Ochsner's plan, and the two exceptions above noted do not touch upon the crux of the question.

BEEKMAN, SMITH and EVERINGHAM reported 500 operative cases, representing the work of many different surgeons in the Cornell Division of Bellevue Hospital, New York; interesting statistical study: highest mortality period begins after the second day of the disease, which parallels similar statistical studies quoted from McWilliams, DeQuervain and combined Berlin hospitals. There were 45 cases of diffuse peritonitis; of these, 12 were of less than 2 days duration; all recovered. By inference, the remaining 33 were of more than 2 days duration; 21 died, 63.3 per cent. No mention is made of Ochsner's treatment, or of any indications for delay and pre-operative treatment in this group. Immediate operation is counselled because of the difficulty in making a diagnosis from the symptoms, "severe cases often showing the least marked signs."

KRECKE (Munich) practices immediate operation in all severe cases.

HAGEN (Augsburg) agrees with Krecke.

ROWLANDS (Guy's *Hospital*) counsels immediate operation in all cases. "If competent surgeon is not available, adopt the Ochsner conservative treatment, . . . an operation must be undertaken if signs of localized abscess or peritonitis develop."

TÉMOIN (Bourges) is the strongest French advocate of immediate operation in all cases, regardless of time or condition. He presents large statistics with remarkably low mortality: report of 1911 gives 1442 acute cases, 37 deaths, 2.5 per cent. In the later group, 169 showed "more or less general peritonitis" with 25 deaths, 14.7 per cent.

CAUCHOIX concurs with Témoïn.

NICOLL dismisses the waiting policy with the remark that "the patient who is shocked as the result of flooding of the peritoneal cavity with pus, will scarce be improved if the surgeon tides him over his shock only to allow him to be overwhelmed with the sepsis of the untreated focus of infection."

BANCROFT reports 485 acute cases from the New York Hospital; mortality, 4.3 per cent. There were 73 cases of acute diffuse peritonitis; 13 died, 17.8 per cent. mortality. There is no discussion of the advisability of delay in any type.

MORF reports 822 cases from the Cook County Hospital, Chicago; the total mortality is 7.4 per cent.; 26 cases were classed as diffuse peritonitis; 17 died, mortality 65.3 per cent. There is no discussion of delay in operation in any type of case.

SLOAN states that his experience with the waiting policy has been bad, and advises immediate operation in all cases. Eisendrath, in discussion, dissented so far as to advise "abstaining from operation in those desperate cases where the pulse is 160 or 180, and they are simply gone." Five other surgeons in discussion agreed with Sloan in advising immediate operation in all cases.

MARTIN DU PAN, in an excellent article on the treatment of peritonitis, outlined the accepted methods in use in France. He advocates immediate operation.

RUNYON advocates combining the methods of Ochsner and Crile. He remarks that "many of our cases we thought would die if not operated immediately, and usually died when so operated, would not only not die when let alone, but would in a short time become safe operative risks." Pre- and post-operative treatment is to be carried out according to Crile's recommendations.

CHIARI (von Haberer's Clinic) states that the practice in this clinic is to operate immediately on every case admitted within forty-eight hours after onset. After the third day, immediate operation is advised unless the case is obviously improved and the inflammatory signs giving evidence of localization. He reports 1167 cases, of which 717 were operated in the acute stage, mortality 6 per cent.; 450 operated in the interval, with two deaths; of 81 cases of diffuse peritonitis, 30 died, 37 per cent. These cases are practically all of more than forty-eight hours' duration, and were all operated immediately after admission. As to the advisability of delay in this group, he quotes the mortality statistics of other clinics, dealing in the same manner with the same type of cases, as follows:

GREKOW .....	45	per cent.
THIEMANN (Riedel's Clinic) .....	62	per cent.
KROGIUS .....	39	per cent.
PROPPING (Rehn's Clinic) .....	40	per cent.
ZAHRADNICKY .....	40	per cent.
HAGEMANN .....	25.4	per cent.

BROWN (England) shows clearly the high mortality of the intermediate stage as compared to the safety of the early and later operation, and attributes this to breaking down the barriers to infection before general resistance has been built up. However, following the English custom, he advocates immediate operation at whatever stage the case is seen.

VOGEL (formerly Kocher's Clinic) does not clearly define indications for operation in his long statistical paper. Evidently the interval operation is preferred, but severe cases are operated immediately, regardless of duration or condition. The result appears to be unfavorable; thus of thirty-six cases operated upon by simple incision, with or without irrigation, thirty-one died. It is noted that all cases that entered the hospital in collapse, died in a few hours after operation.

#### BIBLIOGRAPHY

- Alexander: Penn. Med. Jour., 1920-21, vol. xxiv, p. 135.  
 Bancroft: Jour. Am. Med. Assn., 1920, vol. lxxv, p. 1635.  
 Bazy: Bull. Acad. de Méd., Par., 1919, 3. s., vol. lxxxii, pp. 207, 227.  
 Beckman, Smith and Everingham: Am. J. M. Sc., 1917, vol. cliv, pp. 490-500.  
 Bevan: Surg. Clin., Chicago, 1919, vol. iii, pp. 301, 329.  
 Brown: Lancet, 1921, vol. i, p. 118.  
 Cauchoux: Bull. Méd., Par., 1920, vol. xxxiv, p. 7.  
 Chiari: Beitr. z. klin. Chir., Tübing., 1920, vol. cxx, pp. 326-343.  
 Crile: Jour. Am. Med. Assn., 1919, vol. lxxiii, p. 1655.  
 Deaver: Med. Rec., N. Y., 1918, vol. xciii, pp. 47-52.  
 Martin du Pan: Rev. Méd. de la Suisse Rom., Geneva, 1917, vol. xxxvii, pp. 5-35.  
 Eichhoff: Beitr. z. klin. Chir., Tübing., 1919, vol. cxvii, pp. 356-390.  
 Eunicke: Med. Klin., Berl., 1918, vol. xiv, p. 1112.  
 Gosset and Berger: Presse Med., Par., vol. xxvii, pp. 753-755.  
 Hagen: Münch. Med. Wchnschr., 1919, vol. lxvi, p. 1414.  
 Hartmann: Rev. gen. de clin. et de therap., Par., 1916, vol. xxx, pp. 673-675.  
 Hughes: Brit. Med. Jour., 1919, vol. ii, pp. 373-375.

- Jalaguier : Bull. Méd., Par., 1919, vol. xxxiii, pp. 431-434. Also, Bull. Acad. de Méd., Par., 1919, 3. s., vol. lxxxii, pp. 65-75.
- Jenckel : Münch. Med. Wchnschr., 1917, vol. lxiv, p. 1048.
- Krecke : Münch. Med. Wchnschr., 1919, vol. lxvi, p. 1052.
- LaRoque : N. Y. Med. Jour., 1918, vol. cviii, pp. 1108-1113.
- Löffler : Münch. Med. Wchnschr., 1920, vol. lxx, pp. 501-682.
- Morf : Jour. Am. Med. Assn., 1917, vol. lxviii, p. 902.
- Nicoll : N. Y. Med. Jour., 1917, vol. cvi, pp. 62-117.
- Ochsner : Therap. Gaz., Detroit, 1921, n. s., vol. xxxvii, pp. 77-79.
- Pauchet : Jour. de Méd. de Par., 1920, vol. xxxix, p. 47.
- Quénu : Bull. Acad. de Méd., Par., 1919, 3. s., vol. lxxxii, p. 105.
- Rowlands : Guy's Hosp. Gaz., Lond., 1919, vol. xxxiii, pp. 100-106.
- Runyon : Railway Surg. Jour., Chicago, 1920-21, vol. xxvii, p. 77.
- Sehrt : Med. Klin. Berl., 1917, vol. xiii, pp. 267-270.
- Sloan : Ill. Med. Jour., Chicago, 1920, vol. xxxviii, pp. 323-325.
- Témoin : Bull. Acad. de Méd., Par., 1919, 3. s., vol. lxxxii, pp. 16-24.
- Tuffier : Bull. Acad. de Méd., Par., 1919, 3. s., vol. lxxxii, p. 104.
- Vogel : Arch. f. Klin. Chir., 1921, vol. cxv, pp. 1-85.

## SPONTANEOUS INTRAPERITONEAL RUPTURE OF THE BLADDER

By JOSEPH F. GEISINGER, M.D.

OF RICHMOND, VA.  
STUART CIRCLE HOSPITAL

IN a strict application, the term spontaneous should probably be reserved for a type of bladder rupture dissociated from any trauma whatsoever, either from within or from without. Such cases have been reported, but it will probably be admitted that a comprehension of them involves some tax upon the imagination. Certainly it is difficult to conceive of a bladder gradually distending until it passively permits itself to burst, entirely without any expulsive reaction on the part of its own musculature or of the correlated musculature of the abdominal wall.

It may be appropriate therefore to apply the term to the case to be reported, though it is definitely associated with such trauma as may be represented by the straining efforts of the patient to overcome a prostatic obstruction. No other traumatic element is apparent in the case.

Many instances of rupture of the bladder are recorded in the literature. Usually the injury is associated with distention and an external shock. The distention may be due to prostatic obstruction, stricture, neglect of micturition during drunkenness or other causes. Rising out of the protecting wall of the pelvis and inelastic from over-stretching, the bladder is in such circumstances subject to serious harm. The external shock causing the rupture may come in the form of falls upon the feet or buttocks or abdomen, blows or kicks over the region of the bladder, crushing injuries, the lifting of heavy objects, and so on. The most usual forms of internal trauma are straining at stool, micturition, or during parturition. The recorded cases of rupture of the bladder from indirect force are comparatively rare and those associated only with the so-called internal trauma are exceedingly uncommon. The case to be reported would appear to illustrate two main points:

1. The desirability even in what seems a simple diagnostic situation of carefully weighing unusual symptoms and signs although they may suggest a condition so unusual as to be almost unknown to the observer.

2. Further confirmation of the recorded observation that the peculiar arrangement of the musculature of the bladder wall on its posterior superior aspect makes this the weakest part of the organ, the vulnerability of which is still further increased by the fact that here it is covered only by peritoneum and intestines whereas elsewhere it is encircled by muscles and bones.

CASE REPORT.—K. B., colored, married, male, aged sixty. Entered Memorial Hospital on April 6, 1920, with immediate history of complete retention of urine for forty-eight hours and antecedent history of difficult urination for two or three years with marked frequency day and night. In the present attack,

## INTRAPERITONEAL RUPTURE OF BLADDER

which was his first acute retention, his physician had attempted to pass a rubber catheter but failing to do so had sent him to the hospital.

Examination showed a well-nourished negro apparently in no more distress than would be expected from a distended bladder. His temperature was 100, and his general condition very good. There was no abdominal rigidity but a fluctuating suprapubic mass could be felt extending to the umbilicus. The fact that this mass was more diffuse and less sharply defined than is usually the case with a full bladder was made a matter of comment between the attendant and the interne at the time being, but its true significance was not appreciated. Rectal examination disclosed a huge prostate and very little further attention was given to the diagnosis. The case seemed to present a commonplace picture of acute retention from prostatic obstruction, indicating suprapubic cystotomy. A rubber catheter could not be passed into the bladder but a woven prostatic catheter entered; about an ounce of urine ran out and the flow then stopped. It was assumed that a middle lobe had probably dropped over the end of the catheter and another point, which, in conjunction with the diffuse character of the suprapubic swelling, would have been most helpful toward a true diagnosis, was thereupon misinterpreted, mainly because the possibility of the occurrence of the condition actually present had never entered the mind of the writer.

As suprapubic cystotomy seemed clearly indicated, no further manipulations were made and the patient was removed to the operating room. Under procain anæsthesia the usual suprapubic incision was made. Beneath the recti muscles was found a bulging and oedematous structure which suggested peritoneum but appeared too thick and opaque for it. It did not give the tense sensation of a distended bladder, but, as evidently nothing lay beneath it except fluid, it was tentatively assumed to be the thinned-out bladder wall, and incision was made directly into it. The immediate escape of a large amount of fluid, evidently urine, appeared to confirm the supposition. A finger was inserted through the opening to explore the prostate, and while this manipulation was in progress a knuckle of small intestine insinuated itself between the finger and the upper angle of the incision, revealing an actual invasion of the peritoneal cavity. A general anæsthetic was thereupon administered, the incision enlarged, the fluid in the abdomen, amounting to nearly a gallon, evacuated, the intestines packed off and a thorough inspection made. The bladder was found collapsed in the bottom of the pelvis and on its posterior superior aspect about one and a half or two inches above the posterior peritoneal reflection was a rent large enough to permit the easy passage of two fingers. The edges of the hole were sharply congested and somewhat indurated. The peritoneum was stripped back and closed around two intraperitoneal drainage tubes in such a manner as to exclude the ruptured area of the bladder. The indurated margin of the bladder opening was then excised and closure made from above and below around an intravesical tube. The superficial structures were closed in layers as usual. Microscopic sections of the excised tissue showed no evidence of ulceration or other local condition at the site of rupture.

The immediate post-operative history of the patient was remarkably satisfactory. There was at no time any evidence of serious peritoneal involvement although his urine showed a considerable amount of pus. His temperature went up to 101, but promptly came down and his pulse did not exceed 100. Two days after operation his blood urea nitrogen was 88 mg. and his blood-pressure was 160, 110. His abdomen continued soft, his bowels moved promptly and regularly, suprapubic drainage continued very free, and he was soon eating heartily and apparently on the road to a good recovery. In the light of his operative findings, further inquiry was made into his history. The only additional fact of importance

elicited was to the effect that on April 5th, the day before he entered the hospital, and some twelve or fourteen hours after the onset of his acute retention, he had been straining for some time in an effort to empty his bladder when he suddenly had a pain in his abdomen and, as he expressed it, he "got sick as a dog." He rallied fairly promptly and his only other symptom was mild nausea without vomiting. It was at this time, twenty-four hours before his operation, that the rupture of his bladder probably occurred.

On April 12th, the patient got out of bed while asleep, walked up and down the corridor and lost his dressings as well as the tube in his bladder. He was apparently none the worse for this experience. His renal function reading on the same day was 55 per cent. in two hours.

For the next two months the record was made eventful only by an occasional brief spell of temperature, usually coincident with some obstruction to the bladder drainage which in the main was very free. The specific gravity of the urine fluctuated between 1004 and 1020 but blood-pressure remained fairly steady in the region of 140, 90. Renal function as measured by the dye output varied between 40 and 60 per cent. Urea nitrogen dropped to 17mg. and then to 14mg. After an unusually long stationary period the prostate began to diminish in size. In spite of his excellent progress it appeared desirable, in view of the unusual experience through which he had passed, to defer the added strain of prostatectomy as long as possible, and under ordinary circumstances the patient would have been sent home for several more weeks of drainage. As the character of the attention he would have gotten at home was, however, highly questionable, and as his condition at this time was probably far better than it would have been later after a period without intelligent observation, it was determined on June 22nd to attempt prostatectomy without further delay. The gland was exceedingly difficult to enucleate and came away in several pieces. The extreme density of some areas suggested malignancy but microscopic sections showed nothing but the usual hypertrophy. The patient made a good recovery from this operation and on July 24th, he returned to his home. At that time his suprapubic wound had closed and he was voiding a normal amount of urine through his urethra.

The above case, with introductory observations, was reported before the Richmond Surgical Society in December, 1920. Its existence was recalled to mind by a recent publication\* in which Thomas reports certain experiences with intraperitoneal rupture of the bladder. An excellent review of the literature accompanies this article. Thomas notes the infrequency of the condition, the very scanty text-book or other data, the original gloomy prognosis, the gradual improvement in the meagre surgical statistics, and the still remaining high mortality rate. In 1882 Rivington in his Hunterian lecture declared that he doubted "whether a single unequivocal recovery after intraperitoneal rupture of the bladder has occurred." Six years later Walsham collected seventeen cases in which abdominal section was done. In three the rupture was extraperitoneal; two died and one recovered. Suture was effected in eleven of the intraperitoneal ruptures; five recovered and six died. Simple drainage without suture was done in the other three; one recovered and two died.

Still further improvement was noted in Jones' statistics which in 1903 contained reports of 54 cases. The mortality rate for the entire series was 48

---

\* Intraperitoneal Rupture of the Bladder, by T. Turner Thomas, M.D., *ANNALS OF SURGERY*, vol. lxxvi, No. 1, p. 64, July, 1922.

per cent. In 32 cases previous to 1893 the mortality rate was 63.5 per cent., while in 22 cases between 1892 and 1903 the rate was 27.5 per cent. In the following year Dombin and Papin collected 78 cases with a general mortality of 43.5 per cent. and a mortality between 1895 and 1904 (34 cases) of 20 per cent.

The cause of death is usually peritonitis, shock or hemorrhage. In the case here reported, the patient exhibited no evidence of shock when first seen and gave no history of it except his statement of "feeling sick as a dog" when the rupture occurred. There had apparently been little or no bleeding from the bladder wound. In spite of the presence of a large amount of urine no peritonitis was present when the abdomen was explored and no indication of it subsequently developed. This latter observation emphasizes Thomas' statement that free escape of urine into the peritoneal cavity does not necessarily lead to a fatal peritonitis and would appear to carry it a step farther and indicate that it may actually occur, though probably very rarely, without any peritoneal inflammation whatever.

Thomas comments at length upon the difficulty of accomplishing an effective suture of the lower part of a rent in the posterior or peritoneal wall, where the rupture usually occurs. In the first of his two cases the closure was poor and the patient subsequently developed peritonitis from leakage of urine. In his other case a perfect closure was effected, but the patient died in a few hours. The difficulty of closure he charges to the anatomical relationship of the bladder, its deep position behind the pubis when contracted and the absence of laxity in the bladder wall. He recites similar difficulties of suture encountered by other operations and suggests, with Jones, the beginning of the suture line at the upper angle of the wound, employing each successive stitch as a tractor to draw the rent upward within easier reaching distance. In the writer's case a free exposure was possible and suture could have been effected throughout except for the apparent desirability of vesical drainage pending the future prostatectomy. The separation of the peritoneum from the bladder contributed to this freedom of exposure and the exclusion of the abdominal cavity in this way from the suture line in the bladder would appear to commend itself as a general surgical proposition when it can be accomplished.

In some of the reported cases the bladder wall was sutured throughout and the abdomen closed without drainage, and a certain number of the cases recovered. Notwithstanding the absence of signs of peritonitis, the writer preferred a safety valve in the shape of an intra-abdominal drain, removed as soon as it was demonstrated that no complications were developing. In all the reported cases in which suture was imperfect or not attempted, simple drainage was used, and in quite a number recovery and subsequent perfect restoration of bladder function occurred in spite of the free leakage of urine into the peritoneal cavity and a subsequent prolonged suprapubic discharge. In further confirmation of the ability of the peritoneum to handle successfully an outpouring of urine, Thomas cites two cases of operative injury to the bladder without repair, both patients recovering after simple drainage.

## THE MECHANISM OF THE FORMATION OF URINARY CALCULI\*

By LINWOOD D. KEYSER, M.D.

OF ROCHESTER, MINN.

FELLOW IN SURGERY, THE MAYO FOUNDATION

IN the study of the etiology of urinary concretions we deal with an abnormal type of crystalline precipitation. The constituents of urinary stones include uric acid, urates, calcium oxalate, calcium phosphate, calcium carbonate, ammonium magnesium phosphate, and less often, cystin or xanthin. These materials are all insoluble in water, even within the range of acidity or alkalinity which we find in urine. Crystals of these substances are often found in the urine of normal persons. Usually they are isolated, single, unfused and perfectly formed according to the crystallographic system peculiar to the given material. To ascertain what mechanism is at fault in causing the atypical deposition and fusion of these crystals into a stony concretion is the problem discussed here.

The power of the urine in health to hold these constituents of calculi in solution, or to bring about their deposition as isolated entities, is due to the presence of finely divided particles of organic matter, the so-called protective colloids.<sup>1</sup> The urinary colloids are incompletely known, but are supposed to include the urinary pigments, traces of nucleo-albumin, mucin, and albuminous material from effete cells cast off from the renal parenchyma. The reaction of the urine and the body temperature are also important factors in maintaining urinary solution. Thus highly acid urines will carry more phosphate, oxalate, and carbonate in solution than those which are near to or on the alkaline side of neutrality. Again, uric acid and cystin attain a greater solubility in alkaline urines. However, it must be emphasized that the hydrogen-ion concentration is a secondary factor in maintaining solution, as is evidenced by the relative insolubility of stone constituents in water of the same degree of hydrogen-ion concentration as the urine.

Ebstein and Nicolaier, in 1891, studied the chemical nature of urinary calculi and for the first time produced stones in the urinary tract of animals by feeding oxamid, a derivative of oxalic acid. As the result of their studies these authors held that the inflammatory reactions in the kidneys resulted in the precipitation of urinary salts in the matrix furnished by the exudate, and thus in some obscure way stone had its genesis.

Rainey, in 1856, and later Ord and Shattock, determined the physical principle that colloidal matter *in vitro* would modify crystalline morphology.

---

\* From the Division of Experimental Surgery and Pathology, and Section on Urology, Mayo Clinic.



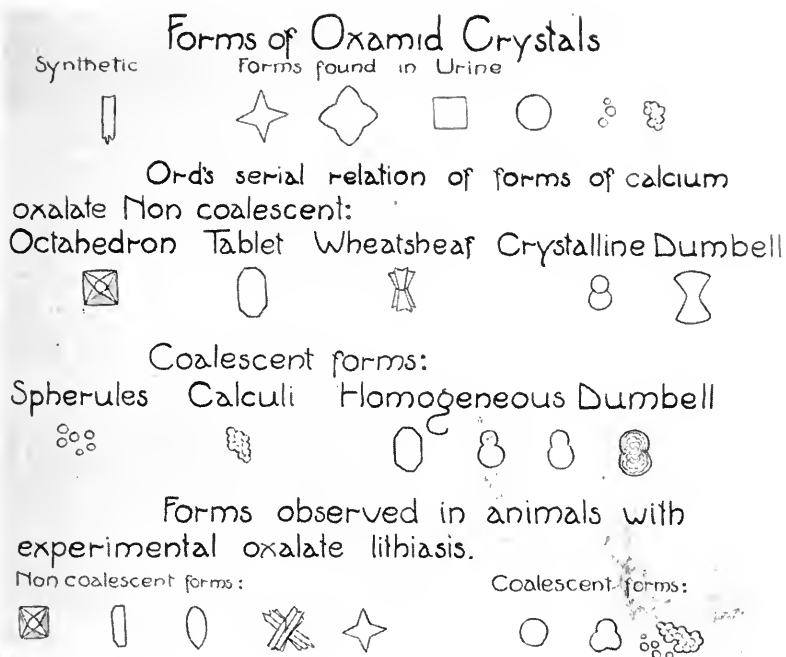


FIG. 1.—A diagrammatic sketch of the serial relationship of non-coalescent and coalescent forms of oxamid and of calcium oxalate crystals. W. M. Ord in 1871 recognized the power of colloids *in vitro* to modify the morphology of crystalline matter and traced the relationship of non-coalescent and coalescent varieties of calcium oxalate as shown above. Later he showed with Shattock that the coalescent forms constituted the structural units of calculi as seen microscopically.

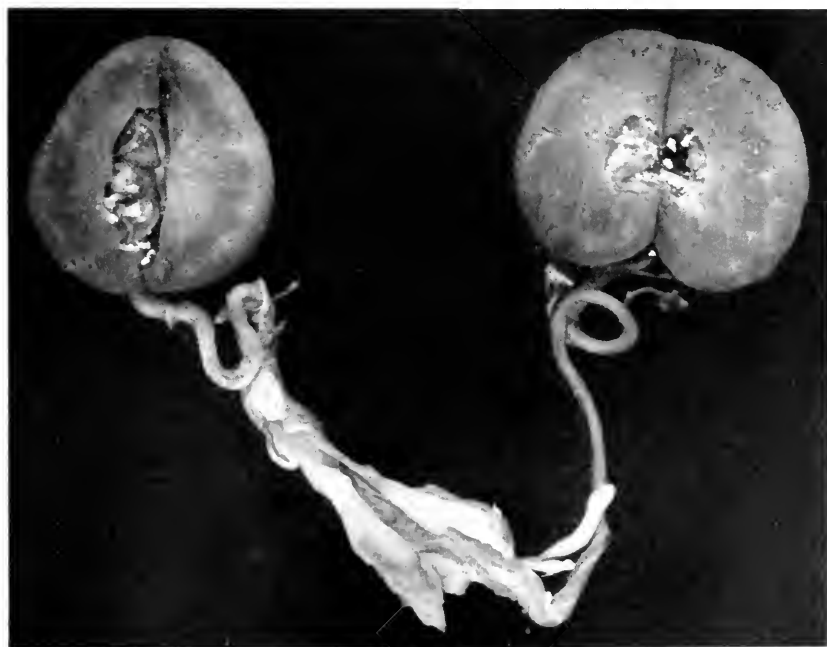


FIG. 2.—Lithiasis from feeding oxamid to rabbit seventeen days.

Thus crystals of oxalate and carbonate of lime would be precipitated from water solution and from solutions containing gelatin, mucin, albumin, and other colloids in widely different forms. Ord, working with calcium oxalate, could trace a number of morphologically related forms which varied consistently according to the amount of colloid and salt present. Furthermore, he found that certain of these crystals tended to remain isolated, while others, especially the spherical forms, tended to fuse. Thus he distinguished between coalescent and non-coalescent varieties of calcium oxalate crystals.

Figure 1 shows these related forms of calcium oxalate in a schematic manner.

Ord's study of the microscopic structure of urinary calculi of oxalate and uratic types led him to the conclusion that the mechanism of their formation might be related to colloidal matter in urine. The demonstration of this relationship, however, remained to be shown.

During the past two years the experimental production of calculi has been studied by the feeding of oxamid. The details of this study are published in another report, but in brief the results were as follows: Synthetic oxamid (diamido-oxalic acid) on being fed to rabbits



FIG. 3.—Formation of oxamid calculus around organic nucleus placed in the renal pelvis. Oxamid was fed for fifty-four days.

and dogs was found to be excreted as such, in the urinary tract. On being deposited from the urine it assumed an entirely different crystalline morphology from that of the synthetic product fed. The crystals had changed from a non-fusing to a fusing or coalescent variety, this fusion of crystals leading to stone formation (Figs. 2 and 3). The process seemed to be related to the urinary colloids as the reaction of the urine did not interfere with the process and as the synthetic oxamid crystals, when dissolved by heating in animal urine, would be reprecipitated on cooling with a morphologic change to the

## FORMATION OF URINARY CALCULI

fusing spheroidal crystalline types. In Figs. 1 and 4 the relationship of the forms of oxamid crystals seen in animal urines may be traced. It is easily seen that the coalescent spheroids are developed from a fundamental cross form.

These experiments suggested that stone formation might be due to one of several factors: (1) The excretion of an excessive quantity of crystalline material beyond the power of the urinary colloids to maintain either solution or deposition of isolated non-coalescent crystals; (2) a deficient amount of

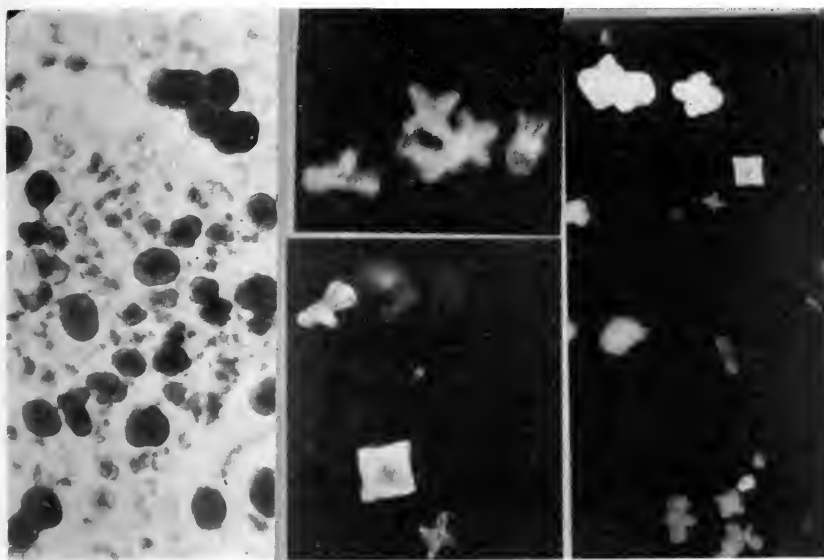


FIG. 4.—Oxamid crystals as observed in urine under the influence of the urinary colloids. These crystals have assumed a morphology altogether different from the synthetic form. We can trace the evolution of crystals through non-coalescent crosses, crosses with interbranchial spaces partly filled out, squared forms and coalescent spheroids.

protective colloid in the urine, and (3) the precipitation of normal colloids or masking of their protective activity by bacterial exudates, or by foreign colloidal matter excreted as the result of an abnormal metabolism. Experimental proof of these points has thus resolved itself into three problems.

### LITHIASIS FROM EXCESSIVE CRYSTALLINE EXCRETION. EXPERIMENTAL CALCIUM OXALATE CALCULI

The difficulties encountered in attempting to increase the visible crystalline content of the urine in substances normally present proved formidable. Aside from the experiments of Minkowski and of Elstein and Nicolaier, who demonstrated small deposits of uric acid in the renal epithelium of animals after the intravenous injection of massive doses of piperazin uric acid or the feeding of large quantities of adenin to dogs, and the finding of occasional

calcium oxalate crystals in the tubules after oxalic acid poisoning, no success in this direction had been obtained. The administration of various solutions of uric acid phosphates and oxalates likewise met with failure in our hands, the oral, muscular and intravenous routes being used.

We then planned a procedure whereby one of the urinary salts could be indirectly concentrated in the blood stream, thus leading to an excess secretion in the urine. As the oral administration of oxalic acid was known to cause the visible appearance of calcium oxalate crystals in the urine, an ester of oxalic acid was used. Normal butyl oxalate was chosen as being adapted to this purpose. It is an oily liquid which can be easily administered subcu-

taneously and it presents the oxalate ion in slight concentration. It may be assumed that on subcutaneous injection it is absorbed and slowly becomes hydrolyzed in the blood stream. The oxalate radical thus liberated combines with the calcium present in the blood and thus calcium oxalate is formed. In order to prevent a marked diminution in the normal blood calcium, a chemically equivalent amount of calcium chlorid in solution was given simultaneously under the skin. In certain instances marked necrotic local reactions in the skin occurred as a result of the injection of these irritating chemicals, and some animals had to be prematurely killed. However, in a number of instances a series of subcutaneous injections were satisfactorily made for



FIG. 5.—Experiment 126. Calcium oxalate stones in bladder, produced by subcutaneous injection of normal butyl oxalate and calcium chlorid.

a number of days consecutively. In this manner we produced intense oxaluria for a relatively long time.

By this method definite urinary calculi were produced in ten rabbits in a series of approximately fifty attempts (Figs. 5 and 6). Many of the animals died, or were killed, during the first few days of the experiments because of cutaneous necrosis mentioned above, or because of the intense nephritis due to the oxalate poisoning.

Table I indicates the duration of life, dosage of oxalate ester and calcium chlorid administered, and the oxalate deposits found at necropsy in a series of fifteen animals carefully studied. One other experiment (Experiment 28), in which 1 c.c. of butyl oxalate and 0.4 gm. sodium oxalate was given daily for six days, gave positive results. Twenty small stones, 2 by 1 mm., were found in the bladder.

## FORMATION OF URINARY CALCULI

TABLE I.

Experiment	Days fed	Nitrogen butyl oxalate, c.c.	Calcium chlorid, 10 per cent. solu- tion, c. c.	Total nitrogen butyl oxalate, c.c.	Total calcium chlorid, 10 per cent. solution, c.c.	Findings
125	6	0.3	1.6	1.8	9.6	Sand in bladder; slight amount in kidneys
126	5	1.0	5.0	5.0	25.0	Sand and calculi in bladder (Fig. 5); no deposits in kidneys
127	3	1.6	8.0	5.0	24.0	No gross deposits. Microscopic deposit of crystals in tubules intense
128	6	0.3	1.6	1.8	9.6	Granules and sand in bladder. Slight amount in calyces
129	8	0.3	1.6	2.4	12.8	Sand in right kidney and small stones in calyx of left kidney. No granules in bladder
130	6	0.5	2.5	3.0	15.0	Sand in both kidneys and bladder
131	4	0.6	3.0	2.4	12.0	No gross deposits
132	24	5.5	2.5	132.0	60.0	Sand in calyces of both kidneys; 2 stones in bladder; ulcerative cystitis with incrustation calcium oxalate (Fig. 6)
133	2	1.0	5.0	2.0	10.0	No deposits; unsatisfactory
134	24	0.5	2.5	12.0	60.0	Small stones in left kidney and bladder; no deposits in right kidney
135	2	0.4	2.0	0.8	4.0	No deposits in calyces or bladder; microscopic deposit crystals in tubule intense
136	28	0.5	2.5	14.0	70.0	Small stones in left kidney and bladder
137	7	0.5	2.5	3.5	16.5	Six small stones in bladder; no deposits in calyces of kidney
138	14	0.5	2.5	7.0	35.0	Small stone in calyx of right kidney; 1 stone and sand in the bladder
139	12	0.5	2.5	6.0	30.0	No deposits in calyces of kidney; several small stones and granules in bladder

## FEATURES OF THE EXPERIMENTS REQUIRING ESPECIAL EMPHASIS

1. Rabbits weighing between 2 and 3 kg., whose urine gave no growth on culture, were chosen.

2. Variable amounts of sand were almost consistently found in the urinary tract of the animals. In approximately one-fifth of them the kidneys or bladder contained definite calculi.

3. Cultures made immediately after death from the kidneys and from the bladder urine were consistently negative for bacterial growth. The only

exception to this was in Experiment 132, in which the animal had lived twenty-eight days and had an ulcerated bladder with oxalate incrustations. A Gram-negative bacillus was grown from the bladder urine.

4. The sand granules and calculi were found to be composed of calcium oxalate.

*Crystallography of Experimental Oxalate Lithiasis.*—A daily study of the urinary sediments from animals receiving the butyl oxalate-calcium-chlorid mixture revealed certain remarkable features from the standpoint of

crystallography. The octahedral form of calcium oxalate is well known. A few hours after the injection of the initial dose of butyl oxalate and calcium chlorid this octahedron was found in the urine. Successive increments of urine showed the oxaluria becoming more intense and as this took place tabloid, dumb-bell, and finally spheroid types of calcium oxalate crystals made their appearance in rapid succession. With the appearance of the spheres, fusion or coalescence of the crystals into little clusters or clumps was noted. Figure 7 shows typical sediments in which the different varieties of

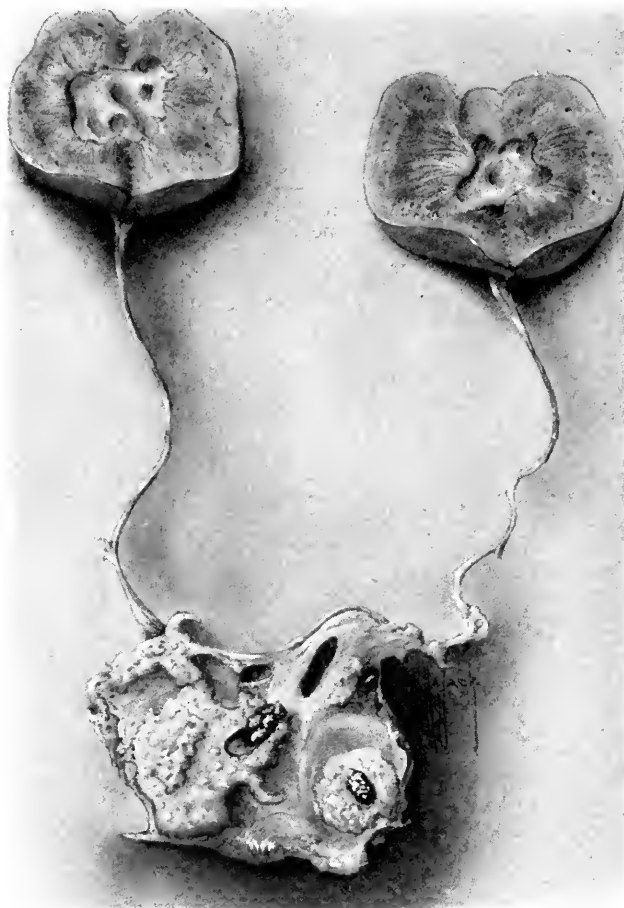


FIG. 6.—Experiment 132. Calcium oxalate stones in bladder. Result of intense oxaluria produced by injection of normal butyl oxalate and calcium chlorid.

oxalate crystals are present. The tendency of the spheroidal forms to undergo fusion or agglutination into larger masses is easily seen. The relatively few octahedral crystals, on the other hand, are seen to be isolated. It was also noted that the sand and calculi found in the urinary tract at necropsy were made up of these spheroidal units. (Fig. 8.)

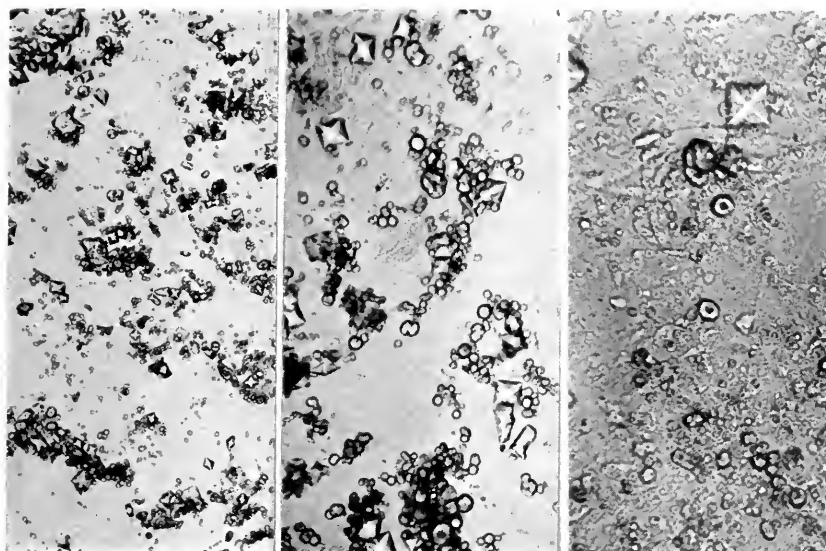


FIG. 7.—Sediments from fresh urine of rabbits with experimental oxalate lithiasis. An intense oxaluria. Discrete isolated perfect octahedra of calcium oxalate are seen, but the preponderant types are tabloids and coalescent dumb-bells and spheroids which are fusing to form concrements.

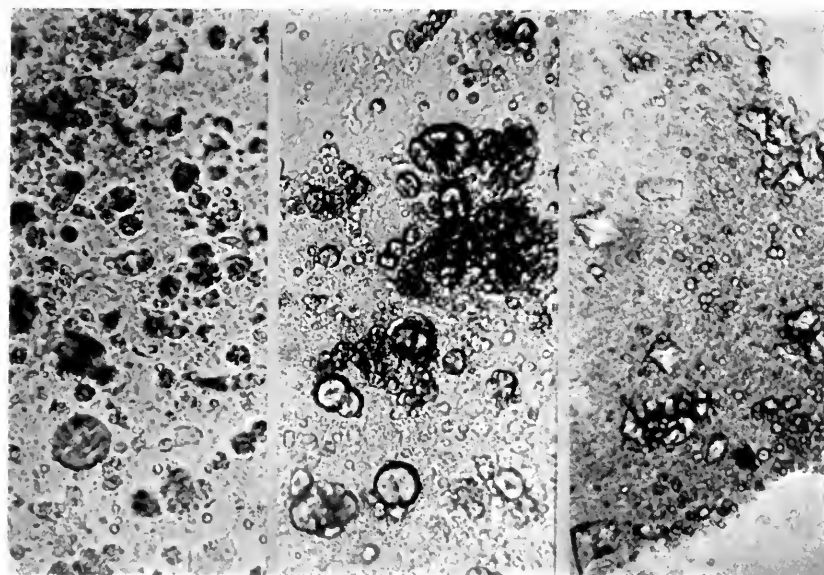


FIG. 8.—Small calcium oxalate calculi experimentally produced as in text, crushed on slides to show crystalline elements in structures. Note that the small fusing spheroids constitute the structural units.

The fusing spheroidal variety of calcium oxalate corresponded morphologically with the coalescent variety described by Ord. When this phenomenon was first noted in the urine of the experimental animals we immediately became hopeful that calculus formation might take place if the process were continued long enough. The results outlined show that our expectations were fully realized.

The kidneys of rabbits with oxalate lithiasis produced in this manner were uniformly swollen and pale. On cross-section the markings of medulla and cortex were partly obscured. Microscopic sections of such kidneys revealed varying degrees of epithelial destruction. Dotting the field in the region of the so-called secreting tubules were found masses of calcium oxalate deposited as rosettes, spheroids, and occasionally as octahedrons. These deposits lay free in the lumen of the tubules. No instances of oxalate deposition within the glomerulus or its capsule or in the proximal convoluted tubules were noted. No intracellular deposits could be determined.† (Fig. 9.)

Thus it was demonstrated that the experimental production of an excessive excretion of calcium oxalate in the urine over a prolonged period of time would result in the aseptic formation of calcium oxalate calculi. Furthermore, it was shown that the mechanism of such calculous production was related to a change in the morphology of the stone-forming crystals from a non-fusing to a fusing or coalescent type.

The physico-chemical influence of colloidal matter on crystalline morphology may theoretically, at least, be applied. We may assume that, by enormously increasing the quantity of the crystalloidal calcium oxalate in the urine, we overwhelmed the protective colloids of the urine which were present only in amounts sufficient to maintain the solution or crystalline isolation of the quantity of calcium oxalate normally present. When the quantity of oxalate excreted passed the limit of that capable of being handled by the urinary colloidal machinery, then fusion of crystals and calculus formation took place.

#### POSSIBILITY OF LITHIASIS FROM A DEFICIENCY OF URINARY PROTECTIVE COLLOIDS

The second phase of our experimental problem, namely, to produce a deficiency in the quantity or quality of protective colloid in the urine of animals, has thus far been baffling. Theoretically such a deficiency would render the urine incapable of maintaining solution or isolated crystal deposition of the normal quantity of crystalloid excreted. Thus, again, change from non-coalescent to coalescent crystal forms would take place and stone formation ensue.

---

† This method of producing oxalate deposits in the renal parenchyma may possibly be applied indirectly in the study of the excretory function of the various renal elements. The constancy of the deposits within the tubules composing the loops of Henle, their absence from the glomeruli, and their relatively slight quantity in the straight collecting tubules, are noteworthy in this connection.



## FORMATION OF URINARY CALCULI

In our hands no positive results in this direction can be reported. However, Lichtwitz has demonstrated that the removal of colloidal matter from

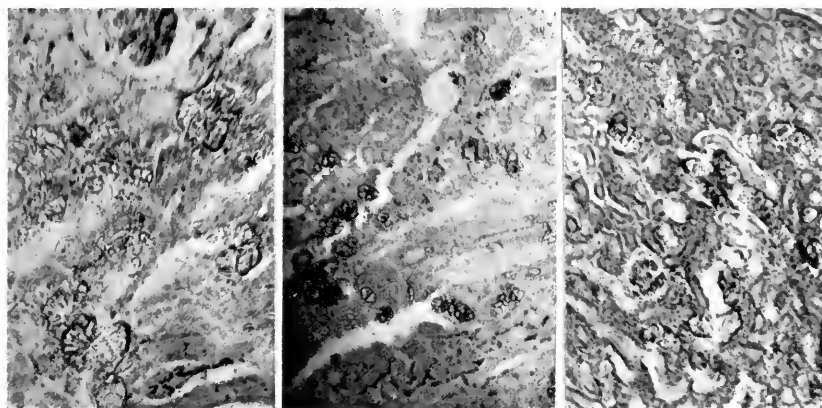


FIG. 9.—Oxalate deposits in renal tubules. A consistent finding in experimental calcium oxalate lithiasis.

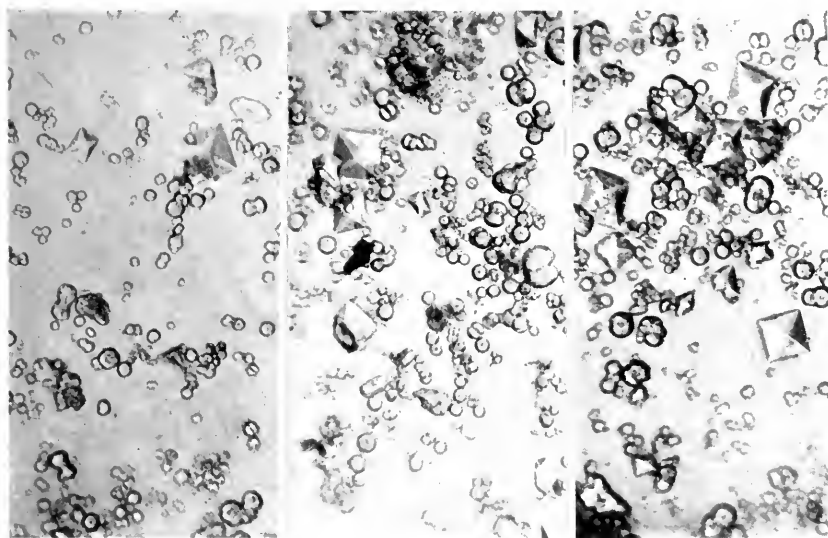


FIG. 10.—Sediment from freshly voided urine of patient A 334473. This patient has been passing calcium oxalate calculi frequently for years. Note similarity of the oxaluria to that experimentally produced. The predominance of coalescent forms is a remarkable feature.

urine *in vitro*, either by extraction with ether or benzene, or by dialysis, uniformly results in a precipitation of phosphates or of calcium oxalate. Furthermore, Schäde of Kiel, in 1909, produced stony masses *in vitro* by clotting fibrinogen in the presence of freshly precipitated phosphates, oxalates, and carbonates, thus giving tremendous impetus to the significance of colloidal factors in stone formation.

Studies tending to show that bacterial exudates may cause an interference with the normal urinary colloids in a manner to bring about an atypical precipitation of the urinary crystals and consequent stone formation have been even more fruitful. Last year it was noted that sodium oxalate fed to rabbits would produce a moderate degree of oxaluria of the octahedron type. By direct infection of the kidneys under such conditions with attenuated colon bacilli, the type of oxalate crystal was found to change to the spheroidal coalescent variety. Fusion of these crystals was noted with the formation of minute concretions in several instances. These experiments have been published in detail elsewhere. Again, Rosenow and Meisser, working with streptococci from the urine of patients with multiple recurrent calculi, have repeatedly produced calculi in the kidneys of dogs by the methods of specific bacteriology. These streptococci were implanted in devitalized teeth of dogs which developed urinary calculi consistently after an interval of several months.

Such experiments can best be explained by assuming that the bacteria have a specific elective activity on the renal tubules, thus producing a low-grade inflammation. The exudate from this inflammatory reaction pours out abnormal colloidal matter into the urinary stream. This we may assume so interferes with the normal colloidal balance of the urine that its solvent power no longer obtains, that deposition of fusing crystals takes place and stone formation occurs.

A single clinical observation in a series which we are now studying seems worthy of mention at this time. Case A334473, Mr. E. H., aged thirty-eight years, was admitted to the Mayo Clinic January 1, 1922. He had been passing sand, gravel, and a number of calculi for four years. Chemical examination of the stones showed them to be composed of calcium oxalate. The microscopic examination of freshly voided urine revealed intense oxaluria with the coalescent or spheroidal type of calcium oxalate crystal predominant (Fig. 10). In fact, the sediment from the urine could not be distinguished from that of the rabbits with experimental oxalate lithiasis. The urine gave a positive culture for streptococci. Eradication of foci and renal lavage was carried out. The patient had syphilis and returned to the Clinic six months later for treatment of this condition. A ureteral stone on the left side, noted at the first examination, was no longer present in the röntgenograms. Pyuria persisted, but no crystalline sediment was found in freshly voided urine. The patient had had but one attack of left ureteral colic since January. Here again is noted an association of atypical fusing crystals in the urine and calculus formation.

# FORMATION OF URINARY CALCULI

## CONCLUSIONS

In conclusion a schematic outline is presented of the possible mechanisms of stone formation in the urinary tract. Not every detail can be considered as final, but believe that the outline is consistent and correlates the clinical and experimental data satisfactorily (Table II).

TABLE II  
*Possible Mechanisms of Stone Formation*

Normal	Normal quantity crystalloid excreted
	plus Normal quantity and quality of urinary colloid yields Solution of crystalloid or deposit of crystals in isolated noncoalescent units
A	<i>Excessive Quantity Crystalloid Excreted</i>
	plus Normal quantity and quality of urinary colloid yields Deposit of <i>Fusing Atypical Nonisolated Crystalline Units</i> and <i>Stone Formation</i>
B	Normal quantity crystalloid excreted
	plus <i>Deficient Protective Activity of Normal Urinary Colloids:</i> 1. Due to deficient quantitative or qualitative excretion of urinary colloid 2. Due to <i>precipitation of the normal urinary colloid</i> or <i>masking of its protective activity</i> by <i>foreign colloids</i> in <i>exudates of specific Bacterial infection</i> , by foreign colloids excreted as the result of <i>abnormal Metabolism</i> or produced locally by the action of some <i>toxic Metabolite</i> yields Deposit of <i>Fusing Atypical Nonisolated Crystalline Units</i> and <i>Stone Formation</i>
C	<i>Excessive Quantity Crystalloid Excreted</i>
	plus <i>Deficient Protective Activity of Normal Urinary Colloids (as under B)</i> yields <i>Excessive Deposit of Fusing Nonisolated Crystalline Units</i> and <i>Stone Formation</i>

It is to be noted that for a *given quantity of crystalloid* the amount of *active protective colloid* present in each case is *insufficient* to maintain solution or *crystalline isolation*.

The need for further study, especially from the biochemic and bacteriologic aspects, must be emphasized. The fact that focal infection, on the one hand, and an excessive excretion of urinary crystalloid on the other, may produce lithiasis, has been demonstrated at least from the experimental standpoint. By clinical application of this knowledge in the study of patients, we may hope to achieve much in prophylactic therapy.

## BIBLIOGRAPHY

- <sup>1</sup> Bechold, H.: Colloids in Biology and Medicine. New York, Van Nostrand, 1918, 464 pp.
- <sup>2</sup> Ebstein, W.: Die Natur und Behandlung der Harnsteine. Wiesbaden, 1884.
- <sup>3</sup> Ebstein, W., and Nicolaier, A.: Ueber die experimentelle Erzeugung von Harnsteinen. Wiesbaden, Bergman, 1891. Ueber die Ausscheidung der Harnsäure durch die Nieren. Arch. f. path. Anat., 1896, vol. cxliii, pp. 337-368. Ueber die Wirkung der

- Oxalsäure und einiger ihrer Derivate auf die Nieren. Arch. f. path. Anat., 1897, vol. cxlviii, pp. 366-388.
- <sup>4</sup>Keyser, L. D.: The Etiology of Urinary Lithiasis. An Experimental Study. Arch. Surg., 1923 (In press).
- <sup>5</sup>Keyser, L. D., and Braasch, W. F.: The Etiology of Urinary Lithiasis. Collective Review. Internat. Abst. Surg., 1922, vol. xxxiv, pp. 1-10.
- <sup>6</sup>Lichtwitz, L.: Untersuchungen ueber Kolloide im Urin. H. Ueber Beziehungen der Kolloide zur Loeslichkeit der Harnsäure und harnsauren Salze. Ztschr. f. Physiol. Chem., 1910, vol. lxiv, pp. 144-157. Ueber die Bedeutung der Kolloide für die Konkrementbildung und die Verkalkung. Deutsch. med. Wehnschr., 1910, vol. xxxvi, pp. 704-706. Die Bildung der Harnsedimente und Harnsteine. Ztschr. f. Urol., 1913, vol. vii, pp. 810-820. Ueber die Bildung von Niederschlägen und Konkrementen im Harn und in den Harnwegen (Phosphaturie, Oxalurie, Uraturie, Cystinurie). Spez. Path. u. Therap. inn. Krankn. (Kraus and Brugsch), 1914, vol. i, pp. 239-296.
- <sup>7</sup>Lichtwitz, L., and Rosenbach, O.: Untersuchungen ueber Kolloide im Urin. I. Ueber Kolloide im normalen menschlichen Urin. Ztschr. f. physiol. Chem., 1909, vol. lxi, pp. 112-118.
- <sup>8</sup>Minkowski, O.: Untersuchungen zur Physiologie und Pathologie der Harnsäuren bei Säugethieren. Arch. f. exper. Path. u. Pharmak., 1898, vol. xli, pp. 375-421.
- <sup>9</sup>Ord, W. M.: Some Experiments Relating to the Forms Assumed by Uric Acid. St. Thomas Hosp. Rep., 1870, vol. i, pp. 335-348. An Account of some Experiments Relating to the Influence Exercised by Colloids upon the Forms of Inorganic Matter. St. Thomas Hosp. Rep., 1871, vol. ii, pp. 1-22. On "Molecular Coalescence" and on the Influence Exercised by Colloids upon the Forms of Inorganic Matter. Quart. Jour. Micr. Sc., 1872, n. s., vol. xii, pp. 219-239.
- <sup>10</sup>Ord, W. M., and Shattock, S. G.: On the Microscopic Structure of Urinary Calculi of Oxalate of Lime. Tr. Path. Soc. Lond., 1895, vol. xlvi, pp. 91-132.
- <sup>11</sup>Rainey, G.: Quoted by Ord and Shattock.
- <sup>12</sup>Rosenow, E. C.: Bacteriology of Cholecystitis and its Production by Injection of Streptococci. Jour. Am. Med. Assn., 1914, vol. lxiii, pp. 1835-1836. The Etiology of Cholecystitis and Gall-stones and their Production by the Intravenous Injection of Bacteria. Jour. Infect. Dis., 1916, vol. xix, pp. 527-556. Elective Localization and Focal Infection From Oral Sepsis. Canadian Jour. Med. and Surg., 1921, vol. i, 31-43. Focal Infection and Elective Localization of Bacteria in Appendicitis, Ulcer of the Stomach, Cholecystitis, and Pancreatitis. Surg., Gynec. and Obst., 1921, vol. xxxiii, pp. 19-26.
- <sup>13</sup>Rosenow, E. C., and Meisser, J. G.: Nephritis and Urinary Calculi Following the Experimental Production of Chronic Foci of Infection. Preliminary Report, Jour. Am. Med. Assn., 1922, vol. lxxviii, pp. 266-267.
- <sup>14</sup>Schade, H.: Beiträge zur Konkrementbildung. München. med. Wehnschr., 1909, vol. lvi, pp. 77-80.
- <sup>15</sup>Schäde, H.: Zur Genese der Gallensteine. Ztschr. f. exper. Path. u. Therap., 1910-1911, vol. viii, pp. 92-124.

## SKIN GRAFTING BY EXACT PATTERN

A REPORT OF COSMETIC RESULTS OBTAINED WITHOUT THE  
EMPLOYMENT OF SUTURES

By BEVERLY DOUGLAS, M.D.

OF NEW HAVEN, CONN.

FROM THE DEPARTMENT OF SURGERY, SCHOOL OF MEDICINE, YALE UNIVERSITY

THE covering of a skin defect by epithelial grafts leads to an early and complete epithelization and so to the minimum cicatrization and scar. This is, of course, of the highest importance from the cosmetic standpoint, and particularly about the face, eyelids, lips, and ears. Moszkowicz<sup>1</sup> and Esser<sup>2</sup> seem to have first described the valuable method of applying Olier-Thiersch grafts cut on molds which are buried in tissues. J. S. Davis applies the term "buried grafting" to this method. Esser makes a mold of sterile dental impression wax of the cavity which he desires to line and throws Thiersch grafts or pedicle flaps over this mold. Then he reapplies it and draws the edges of the graft to the skin edges which have been slightly undermined or else draws the skin edges together over the mold. This he found to be useful especially for lining gum,



FIG. 1.—Method of trimming Thiersch-type graft to exact rubber-tissue pattern.



FIG. 2.—Application of patterned graft to wound of ear. Removal of pattern.

lip or ear defects, but also used it to cover the space from which Thiersch grafts were cut. Weiser<sup>3</sup> modified this method for shallow surface wounds by fixing the mold on the cheek by a through-and-through nail with a flat adjustable screw head like a cuff link. Parce<sup>4</sup> working with Keller has reported a series of several wounds of a more superficial nature on which the Esser method was employed. The skin edges were undermined in each case, and throughout this work Parce used rows of sutures to hold the grafts in place.

Our purpose has been to develop a method for exactly covering superficial wounds with epithelium without the necessity of undermining the edges and without the employment of sutures. The outlines of our wounds have, as a rule, except for their color contrast, been indistinct. Therefore rubber tissue seemed more desirable than wax for patterning their contour.

The method of using rubber tissue for patterning wounds in order to determine their exact area was recently published by the author in this journal.<sup>5</sup>

This and similar material has been employed for so many purposes in surgery that the writer claims no novelty in the present one. In view, however, of the good cosmetic results obtained in several recent cases, it has seemed expedient to describe in accurate detail the technic employed throughout.



FIG. 3.—After care: Lifting edge of graft to allow serum to escape. Spraying lightly with paraffine to prevent excessive drying.

On November 27, 1921, the Rialto Theatre fire flooded the New Haven Hospital with patients having first, second and third degree burns. As no patient escaped burns of the face, including the ear, the problem after the first few weeks became a cosmetic one. The writer reports the technic employed on the ears as best illustrating the value of the method. The problem here was how to provide hairless and color-matched skin over the entire burned areas on the ears; incidentally, in the more severe cases, to prevent the deformity incident to contraction of scar tissues.

In one of the cases a cartilage transplant was necessary to restore the contour of the ear. In the others, this was not done. Antiseptic solutions were



FIG. 4.—Burn of ear before grafting. FIG. 5.—Burn of ear before grafting. FIG. 6.—Burn of ear before grafting.

employed until the ears presented clean superficial granulating wounds of varying extents and outlines. The method used was as follows:

A. Patterns are made of the exact outline of the wound; either cutting out the rubber tissue directly with scissors, or tracing it with ordinary fountain pen ink and then cutting out. This is done either at operation or the day before, as is more convenient.

B. The right and left sides and the anterior and posterior surfaces of the patterns are labeled so as to avoid error.

## SKIN GRAFTING BY PATTERN

C. After the usual iodine technic to the skin, the grafts are cut by the Thiersch method, using the regular Thiersch knife or a safety razor blade set in clamps. Since it is desired to have the skin hairless and very thin and soft,



FIG. 7.—Method of fastening pattern grafts to auricular surface.



FIG. 8.—Method of fastening pattern grafts to auricular surface.

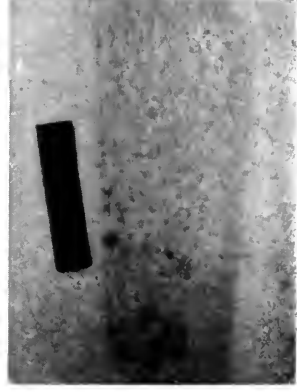


FIG. 9.—Wound left by removal of skin for ear. Six months post-operative.

the grafts are cut from the upper and external aspect of the thigh, below the belt line. If grafts of hairless skin could not be obtained, it would be advisable to "depilate" the grafts later by X-ray application. In determining the size of the grafts which will be necessary, one should keep in mind that



FIG. 10.—Final result on patients shown in figures 6 and 7.



FIG. 11.—Final result on patient shown in figure 8.



FIG. 12.—Final result on patient shown in figure 4.

the skin will shrink to about two-thirds or one-half of its previous size. Therefore the skin should be cut somewhat larger than the size that will cover the pattern. If, after cutting, the graft seems too thick, the excess fat may be removed by trimming its under surface with curved scissors. The pattern, with its posterior surface up and its right and left sides reversed, is then placed on a board and the graft spread out over it with the epithelial surface down. With the scissors, the edges of the already contracted skin are then

trimmed accurately to the edges of the pattern (Fig. 1). The excess skin may be put back on the wound or used for "pinch" grafts in other locations.

D. Next, the wound is cleansed with ether and the graft applied to it. After approximating the edges of the graft to the edges of the wound (Fig. 2), the rubber tissue may be peeled off. The graft is then fastened to the ear, the skin of which has been thoroughly cleansed with ether, by means of plain adhesive strips about 4 mm. wide (Figs. 7 and 8). Each strip is made taut



FIG. 13.—Final result on patient shown in figure 5.

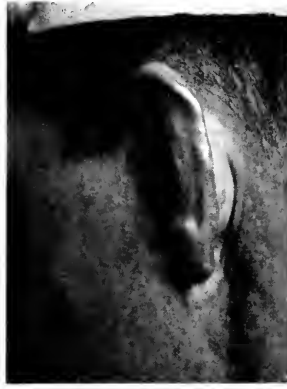


FIG. 14.—Final result on patient shown in figure 5.



FIG. 15.—Keloid on burn of ear which was not grafted. Four months post-operative.

and is placed about 5 mm. from the next one. A pasteboard box held by tapes is then applied over the ear. After twelve hours, serum which will be found to have collected under the graft may be carefully removed by lifting up the edges with sharp sterile scissors which are wiped with alcohol between each puncture. The graft, still held by adhesive, which has been made more taut wherever necessary, is then sprayed lightly with a very thin layer of "Ambrine" or other paraffine preparation (Fig. 3.) The box dressing is reapplied. Usually in about six days it will be found possible to remove the adhesive strips without interfering with the grafts. The color of the grafts through the light coating of wax may be taken as an indication for the time of removing the adhesive. This may be done as soon as the grafts are definitely pink.

The summary of the cases treated in this manner is as follows:

Eight patients entered the hospital on the same day, November 27th, and all had first and second degree burns of the ears. (Figures 4, 5 and 6 show the burns of the ears of three patients before grafting.) The same type of grafts could therefore be applied to all. Of these, one was a female and the other seven males. Practically all were in a station of life where cosmetic results were highly desirable. In four, one ear was grafted; in the other four, grafts were applied to both ears. Five had previous skin grafts by other methods which proved unsuccessful. In six cases using this method, success was com-



plete; in the other two the grafts on one ear took well. On the opposite ear, in each case slight secondary infection temporarily caused a failure of a small portion of the graft with subsequent delayed healing.

In all cases, as the epithelial edge grew over the slight linear defect, the line of demarcation between the graft and surrounding skin became almost imperceptible. The color assumed by the grafted skin was very nearly that of the surrounding skin of the ear. All of the cases have been observed for a period greater than four months and results are satisfactory to the patients from a cosmetic standpoint. No hair has grown in the skin, which was chosen from a hairless site.

Figures 9, 10, 11, 12, 13, 14 and 15 are self-explanatory.

## CONCLUSION

A method is described for the making of exactly patterned Thiersch grafts. Such grafts can be applied without suture or other mechanical methods of fixation and heal with the minimum of scarring.

## REFERENCES

- <sup>1</sup> Moszkowicz, L.: *Archiv f. clin. Chir.*, Berlin, cviii, No. 2, p. 216.
- <sup>2</sup> Esser, J. B.: *ANNALS OF SURGERY*, March, 1917, vol. lxxv, p. 297.
- <sup>3</sup> Weiser: (quoted by Esser).
- <sup>4</sup> Parce, A. D.: *ANNALS OF SURGERY*, vol. lxxv, No. 6, June, 1922, p. 658.
- <sup>5</sup> Douglas, B.: *ANNALS OF SURGERY*, vol. lxxiv, No. 6, June, 1921, p. 673.

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting Held October 25, 1922*

The President, DR. JOHN A. HARTWELL, in the Chair

## TRANSPLANTATION OF TOE

DR. HAROLD NEUHOF presented a girl seven years of age who was admitted to the Surgical Service of Doctor Lilienthal, Mt. Sinai Hospital, July 11, 1922, with congenital deformities of the hands presumably due to amniotic bands. On the left hand there was fusion of the third, fourth and fifth finger stumps and deformity of the left thumb and index finger. On the right hand the index finger lacked the distal phalanx and the middle finger was completely lacking. The other fingers were intact.

The first operation was a plastic procedure on the soft parts of the left index finger and thumb, with some resulting improvement in appearance. The second plastic procedure was for the separation of the fused stumps of the third, fourth and fifth fingers. For the defect of the middle finger of the right hand, a transplantation of the second toe with the adjacent tissues of the ball of the left foot, was planned. The first stage of the transplantation was carried out August 21, a plaster casing for the child being made a few days before. At the operation, the skin over the stump of the finger was reflected as a flap to the ulnar side, exposing the end of the bone directly adjacent to the metacarpal joint and the termination of the flexor and extensor tendons of the finger. The end of the bone was freshened and curetted, a wet pack was put in place, and the isolation of the second toe proceeded with. An incision was made across the web between the first and second toes, the incision being carried well up on the dorsum of the foot and down along its plantar surface. This incision made it possible to expose the second metatarsal bone with the flexor and extensor tendons of the second toe with the minimal dissection. The tissues over the lateral aspect of the second toe were left undisturbed, thus assuring an adequate blood supply. The second metatarsal was divided about 2 cm. from the head of the bone and the extensor and flexure tendons divided at this level. It was of course essential to transplant more than the toe itself in order to supply the desired length for the replacement of the missing finger. As a result of some further dissection the second toe with the adjacent metatarsal tissues hung on a pedicle consisting of the tissues on the lateral aspect. The greatest difficulty was in approximating foot and hand without tension. This was accomplished by drawing the left knee

well up, rotating the left leg externally at the hip and elevating the shoulders, particularly the right. Sutures of silk were now passed between the extensor and flexure tendons of the missing finger and the distal ends of the corresponding divided tendons of the toe. A suture of chromic gut was passed through the bone stump of the finger and the distal end of the divided metatarsal bone. After the hand and foot were fixed in the position in which adequate approximation of the tissues was possible, these sutures were tied. The flap of skin that had been reflected from the stump of the missing finger was sutured to the skin where it had been incised for the separation of the toe. The remainder of the skin incision on the foot was packed.

The post-operative course was trying for the patient and opiates were required to keep the child quiet in the necessarily uncomfortable position. She became accustomed to the position, however, after a few days. The sutures were removed on the sixth day. It was found that some separation of the skin had occurred owing to shifting of position and adhesive plaster was applied to maintain apposition. The toe remained warm and its circulation was good. Fifteen days after the first stage, the second stage was carried out. This consisted in making an incision along the lateral aspect of the second toe, in order to detach it. The space in which the dissection could be carried out was cramped, so that some injury to the tendons was probably inflicted. After the separation of the toe, together with the adjacent metatarsal bone and tissues, was carried out, it was evident that too much tissue existed in the ball of the foot for a satisfactory cosmetic result in the hand. It was therefore necessary to sacrifice not only the distal end of the metatarsal bone, but also much of the fat pad on its plantar surface. After this trimming of the tissues had been done the skin along the lateral aspect of the base of the toe could be sutured to the skin edge that was raised along the radial aspect of the stump of the finger. A few fine silk sutures were employed for this purpose. A splint was applied to the hand and the wound of the foot was strapped to obliterate the gap left by the loss of the second toe. After the patient recovered from the anæsthesia, the dressings were removed from the operative field of the hand, a thin layer of gauze put in place, and dry warmth with the aid of an electric light was employed. The process of repair appeared good, skin union and apparently union of the soft parts occurring. The circulation in the transplanted toe remained good from the outset. Sensation has begun to return, being now present to some extent over a considerable area of the skin of the transplant. X-rays show that the bones and joints of the transplant are as yet apparently normal. Slight motion is present in the transplanted toe but it has not as yet been determined that the tendons are intact. An operation for their repair may be indicated in the future. The cosmetic result is a great improvement over the previous appearance, but it is as yet too soon to state what the final outcome will be.

## PYOARTHROSIS OF THE KNEE

DR. HAROLD NEUHOF presented a woman, forty-two years old, who was admitted in March, 1920, to the medical service of Mt. Sinai Hospital with a history of cough and fever for four weeks, and a purulent discharge from the right ear for three weeks. Pain and swelling of right knee were first noted about two weeks before admission. Upon admission to the hospital there were the physical signs of an unresolved pneumonia in the right lung. The knee-joint presented a marked effusion with increased local heat. The appearance was suggestive of a gonorrhoeal arthritis, and a vaginal smear that was made showed gonococci. The patient was under observation for several days, during which period of time the joint lesion progressed. A white blood count and differential were normal. Slight fever was present. He aspirated the joint and found pus containing streptococci in spreads and operation was proceeded with. At operation there was found a large collection of pus in the knee-joint and the suprapatellar pouch. There were as well extensive pockets of pus and necrotic tissue behind and below the knee-joint, mesial to the heads of the gastrocnemii, and two similar pockets mesially situated to the hamstrings. These foci were laid wide open, and found to communicate with the posterior aspect of the knee-joint. Numerous Carrel tubes were introduced in the various pockets and to, but not within, the knee-joint for the administration of Dakin's solution. For about a week it was necessary to give anaesthesia to do the dressings. Carrel-Dakin treatment was then discontinued and gentle passive motions were begun. Active motions could only be instituted some two weeks later and then with the greatest difficulty. The wounds healed without complication but the improvement in the range of motion was very slow. The patient left the hospital with almost complete fixation of the joint and failed to go to the department of physical therapy for after-treatment. Upon examination at the follow-up clinic, the patient complained of generalized joint pains. A greatly enlarged spleen and liver of unknown etiology were found. The patient has a useful knee for ordinary purposes, with good power in the limited range of motion. Extension is complete, flexion is limited to about 90 degrees.

DOCTOR NEUHOF presented also a boy, fourteen years old, who was admitted to the surgical service of Mt. Sinai Hospital February 13, 1922. Ten days before admission coryza and fever had been present for forty-eight hours. Pain in the left knee set in two days later. This became progressively more severe. The joint became swollen and tender. High fever up to  $104^{\circ}$ , began three days before admission, and persisted. On admission the patient looked acutely ill, with a dry tongue, and in agonizing pain. The only positive finding other than the knee-joint was an acutely inflamed pharynx. The knee-joint was tense with fluid, exquisitely sensitive, the overlying skin hot to the touch. The suprapatellar pouch was distended and the surrounding

soft parts were infiltrated. Blood culture was negative. At operation the joint was first aspirated, pus containing streptococci in spreads that were made being found. Free lateral joint incisions were made, from the top of the suprapatellar pouch to the bottom of the knee-joint, traversing the quadriceps musculature. The joint contained pus under tension, and the suprapatellar pouch presented a perforation in its uppermost portion where the pus had begun to extend into the muscular planes. No drains were inserted. A temporary splint was applied. From the outset active motion was tried. Even with liberal administration of morphine it was soon found that this could not be carried out by the patient. Resort was therefore had to passive motions, which were gently carried out, within the limits of pain, every two hours. The temperature dropped to normal by lysis in one week. For three weeks no really active movements could be instituted. Then, with the aid of a Bier bandage applied around the mid-thigh, they could be begun by the patient. The support of the body weight and efforts at walking were not possible until six weeks after operation. Rapid improvement in the range of motion and power then set in. Normal function is now present in the joint, with full range and power. There remains some atrophy of the thigh musculature.

DOCTOR NEUHOF presented also a boy, ten years of age, who was admitted to the surgical service of Doctor Lilienthal, Mt. Sinai Hospital, on January 25, 1922, with a week's history of pain in and swelling of the left thigh, high fever, delirium. He presented a profoundly septic appearance with great enlargement and tenderness of the left lower thigh. The left knee-joint was held slightly flexed, motions were limited, and there were evidences of an effusion into the joint. A blood culture taken before operation was later reported positive, six colonies of staphylococcus aureus to the cubic centimetre. At operation, directly after admission to the hospital, the knee-joint was aspirated. Cloudy fluid was obtained containing very few cocci in spreads. It was therefore decided to deal with the bone lesion alone. A subperiosteal abscess entirely surrounding the femur in its lower half was incised. Massive necrosis of this portion of the femur and multiple pus foci were encountered when the bone was laid open. Carrel-Dakin treatment was instituted from the outset. The general condition of the patient remained poor for five or six days after operation, although the temperature dropped towards normal and the progress of the wound was satisfactory. The point of significance here is the fact that the moderate effusion in and limited motion of the knee-joint persisted. Ten days after operation the temperature began to rise. Although there was no evident change in the condition of the knee-joint other than apparently increasing sensitiveness over the inner aspect, it was thought advisable to explore the joint. Upon aspiration of the joint only a small quantity of pus was obtained and it was therefore believed that the suppuration had spread to the periarticular bursæ and an incision was made over the

posterior aspect of the joint laterally to the vastus internus. Pus under tension was encountered here, and the tract was found to communicate with a wide opening into the joint. The articular surface of the femur in this region was denuded and roughened and was apparently the source of infection. The posterolateral bursæ were not explored and this proved to be an error as the subsequent course showed. The temperature ranged at a lower level, but the patient's general condition did not improve. Active motions of the joint could not be carried out, but limited passive motion was possible. Finally, some fulness in the popliteal region appeared and an incision was made to expose the posterolateral bursæ one week after the previous operation. Two small pockets of pus and necrotic material were encountered in the region of the bursæ. These communicated freely with the posterior aspect of the joint from which pus escaped. After this operation, active motions of the joint could be carried out by the patient despite the extensive wound in the femur, and convalescence was rapid. In this case it is noteworthy that the usual incisions laterally to the patella proved unnecessary in the treatment of the knee-joint infection. There now remains a large sequestrum of the femur extending almost to the knee-joint, which will require operation. The thickened bone that surrounds it interferes with full flexion of the knee, the bony impact being felt upon flexion to 100 degrees. Full extension is present.

DR. JOHN A. HARTWELL said it would be interesting to know if any other member of the Society has had experience with the Willems' treatment and, if so, if the results have been as satisfactory as they have been in Doctor Neuhof's cases. The Willems' treatment was intended for traumatic arthrosis, which is different from the septic conditions of private life where infection is through the blood stream. It was the speaker's opinion that these latter patients will not make the needed effort at coöperation and that they are unable to put into effect the walking treatment.

DR. ALLEN C. WHIPPLE noted that Doctor Neuhof had brought out one point, and that was the difficulty in getting these patients to use active motion. The speaker had had several of these cases in the last year and a half, and this was one of his greatest problems in carrying out this form of treatment. The intelligent patient will coöperate and carry out active motion; if there are no secondary pockets and if there is no osteomyelitis, the results are astonishing. But in his four or five cases, in children, particularly in two where both extremities were involved, the carrying out of active motion was out of the question.

DR. ROYAL WHITMAN said that in cases of the type shown, active movement as a means of drainage was impracticable because the tissues outside the joint, even the muscles themselves, were involved in the disease, and voluntary motion was therefore inhibited by pain.

DR. HUGH AUCHINCLOSS thought the crux of the whole thing was the early stage in which treatment could be started. He had in mind one patient who had a small focus in the inner condyle of the femur demonstrable

## DIVERTICULITIS OF STOMACH

in four or five days. The boy, nine or ten years of age, was very sick. He had a suppurative knee-joint. There was a small bone focus in the shaft near the epiphyseal line which was drained. He had six positive hæmolytic staphylococcus aureus blood cultures, and six aspirations of greenish-white pus from the joint with 1 per cent. carbolic washings into the joint after each aspiration. With the exception that he had a certain amount of varus deformity, he has regained complete function in the knee-joint which was never drained. If localized infections in the bone or soft parts about the joint are adequately drained early, before necrosis of the joint lining has taken place, joint drainage may be quite unnecessary and aspiration suffice.

DR. EDWIN BEER believed that after this presentation of the good results of the mobilization treatment of suppurative conditions of the knee, it would be well to give some attention to the poor results. One can never tell in advance how a suppurative knee-joint is going to behave. Similar cases treated along parallel lines have behaved surprisingly differently. The speaker had had to do an osteotomy to straighten out deformity following the use of the Willems' method. It was certainly an improvement over the old drainage operations, although cases did not regularly give as satisfactory results as had been shown this evening.

DOCTOR NEUHOF, in closing the discussion, said that his experience with the Willems' method of treatment was limited to some eight or ten cases, and the patients selected for this evening's presentation were chosen because they did not all represent ideal results. All the cases he had seen, however, had useful limbs with some degree of motion, and he had not experienced the extremely unsatisfactory results to which Doctor Beer referred. The point he wished to emphasize was that he had not usually found it possible to carry out the Willems' treatment, as far as active motion was concerned, in civil practice. He believed that the method of free incisions and omission of drainage tubes, etc., was a great advance in the treatment of knee-joint infections. But in his experience active movements after operation cannot usually be made by the patient. In contrast to healthy soldiers with knee-joint lesions, these are patients who have a systemic infection of which the affection of the knee-joint is but one manifestation and who are usually debilitated by the disease. In connection with Doctor Whitman's statement that active extension of the knee-joint is impossible, the speaker said that those who have seen wounded soldiers with knee-joint infection treated by the Willems' method have seen that they do have active extension at the knee. Satisfactory results, however, could be obtained by passive movements.

## DIVERTICULITIS OF STOMACH

DR. JOHN F. CONNORS presented a woman, twenty-five years old, who was admitted to the hospital on August 16, 1922, with a diagnosis of appendicitis. Chief complaint, distress after meals. Family history, negative. Previous history, indigestion for the past five years, otherwise irrelevant. Present history: Day before admission patient began to

feel sick, complaining of headaches, nausea and cramp-like pains throughout the abdomen. Upon questioning the following history was elicited: Immediately after a few mouthfuls of food there is a fulness in the left upper quadrant of the abdomen. Patient says she is able to relieve this by massage and moving about. Lately she has been taking her meals standing. With this distress there are frequently gaseous eructations and sour tastes, but there is no vomiting. This distress is always in the same area, *i.e.*, in the left upper quadrant of the abdomen, in which constant tenderness is present. She does not suffer from hunger pain. Of late she has discontinued using sour liquids and starchy foods, because of the great distress which follows. Vegetables and cereals are her principal diet. Physical examination shows a vague tenderness over the entire abdomen. There is no marked tenderness or rigidity. Blood count on admission was: Leucocytes, 16,000; polymorphonuclears, 81 per cent.; lymphocytes, 19 per cent.; erythrocytes, 4,250,000; hæmoglobin, 80 per cent. The urine was negative. Wassermann was negative. As it was felt that she did not have an appendix, a G. I. X-ray series was ordered, which revealed the following:

Six-hour examination reveals a retention in a pouch-like formation of the greater curvature, pars cardia, just opposite the epicardial portion of the œsophagus. There is no other gastric retention.

As two more tablespoonfuls of the barium mixture are given, this does not fill the pars pylorica as usual but fills the pouch first; as more of the opaque mixture is given the last overflows the pouch and passes into the pars pylorica. The pouch formation which appears like a diverticulum is persistent on three different examinations. The last examination having been done after administration of tincture belladonna (as antispasmodic) for five days 15 drops t.i.d.

Similar cases have been described occasionally in English and foreign literature under the name of "cascade stomach," which this pouch may resemble. In cases of "cascade stomach" there is marked distention of the splenic flexure of the colon, which presses constantly on the pars cardia, the constant pressure forms an artificial diverticulum and later due to irritation, adhesions may be formed between this pouch and surrounding serous membranes.

At operation, for a vertical distance from 1 to 2 inches opposite the spleen and the corresponding gastric border the connecting omentum was apparently absent, leaving an opening. This opening was bounded above by a distinct and strong band (1 inch by  $\frac{1}{4}$  inch), extending from the cardia to the spleen and containing blood-vessels of a size to give rise to active bleeding until secured by double ligatures, and separated by a slight interval from the upward continuation of the gastro-splenic omentum and the remains of the dorsal mesogastrium, which was thin and apparently bloodless.

Below, this opening was bounded by a firm, sharp margin which was continuous, inferiorly and to the right, with the remainder of the



gastro-splenic omentum and gastro-colic omentum. Near this sharp margin ran a blood-vessel of good size which resembled, and followed the course of, the gastro-epiploica sinistra.

This opening led into the lesser peritoneal sac, as was demonstrated when a finger introduced through an artificial opening in the gastro-colic omentum could be touched by another through the above-mentioned opening.

Through this space the greater curvature (slightly) and a varying amount of posterior gastric wall, depending upon the amount of gastric contents to push it forwards, would protrude and overhang the sharp lower margin.

There were no adhesions, induration or other evidences of inflammation. The stomach walls were quite normal, save for apparent slightly thinner wall in the region of the herniated portion, as from repeated stretching.

## ARTERIOVENOUS ANEURISM

DR. JOHN F. CONNORS presented a young woman, twenty-five years of age, who on July 4, 1922, sustained several severe cuts on the right forearm, following the breaking of a wind-shield. These were sutured by a physician. On July 28th, three weeks after the injury, patient noticed a small localized swelling on the right forearm at the site of the previous injury. This swelling has gradually become larger and more painful. Physical examination is negative except for the local condition. There is an expansile, pulsating swelling just below the bend of the elbow on the radial side of the forearm. At present it is the size of a marble. The characteristic bruit can be heard and was transmitted upward to a more marked degree than below. The radial pulse could be felt at the wrist, but there was a decided difference between the right and left sides. There was no apparent swelling of the forearm. For the past two weeks she says the pain has been increasing.

*Operation.*—An incision was made to the inner side of the swelling and with the exception of a few adhesions the aneurism was easily exposed and dissected free. There were no branches leading into the sac which was entirely venous, and no distention of the coats of the artery. A catgut ligature was placed above and below the sac on the vein. A ligature was placed around the artery above the aneurism. This ligature was not tied, but by pulling it angulated the artery and controlled the bleeding. The sac in the vein was then bisected, making two uneven flaps. An opening in the artery about 1 cm. in diameter was found. The ligature was loosened and the bleeding became active. The ligature was then drawn taught and the repair of the artery was made by a transverse suture of chromic catgut. The coats of the vein were placed over the suture line and this was reinforced by a piece of fascia and the wound closed in layers. There was improvement in the radial pulse but there is still some difference, and I do not feel that

there is as much improvement as I expected from my experience with other cases of similar character. The patient is free from pain and has perfect function of her arm.

He was led to operate upon this case by the history of the increase in size of the swelling. He had deviated from the orthodox method of smearing the tissues with petroleum as advocated by the early workers in this field which was intended to impede coagulation by the dropping of a one per cent. solution of sodium citrate into the field of operation.

#### SUPPURATIVE PERICARDITIS

DR. EDWARD WADSWORTH PETERSON presented a child, aged three and one-half years, who was admitted to the service of Doctor Dennett, at the Post-graduate Hospital on June 14, 1922, with a history of being ill for two weeks before admission, with loss of appetite, occasional vomiting, green stools, and constant elevation of temperature, fever as high as 104. The mother claims that the illness began just after the child was struck on the head with a stone, although there was no evidence of any trauma whatever. There was much complaint of frontal headache. On the ninth day of her illness she had a convulsion, lasting 20 minutes. She had been coughing for two days before coming to the hospital.

June 15, 1922: Physical examination showed nothing out of the ordinary except "few crackling râles and bronchial breathing heard just outside and below nipple." Diagnosis, broncho-pneumonia.

June 23, 1922: "Heart sounds are very distant, rate about 140, regular. Heart area enlarged to right of sternum, and dullness extends on left to anterior axillary line in third and fourth interspaces. Thick mucous râles heard over both lungs anteriorly and posteriorly. Dullness and diminished breath sounds at right base, probably due to enlarged liver. Liver palpable three fingers below right costal border."

X-ray examination showed a rather large pericardial effusion. The child, while acutely ill, had not been in a critical condition until June 20th, when the temperature rose to 104, respiration 40 to 60, and pulse 160. The breathing became labored. There was cyanosis of the lips. On June 23, Doctor Sanctis introduced a needle and withdrew thick pus from the pericardium. On the following morning, with the child in a sitting posture, on account of dyspnoea, under local anaesthesia, the left sixth costal cartilage was resected, the internal mammary artery ligated and the pericardium exposed, without opening the pleura. The pericardium was seized with fine clamps and opened. Thick pus, under pressure, escaped. With a suction apparatus such as is used in throat operations the remaining pus was aspirated. The pericardium was sutured to the chest wall. *No drains were used.* Following evacuation of the pus there was marked improvement in the patient's general condition. In order to secure good drainage, the child was made to lie face downward, for a period of thirty minutes, every two or three hours. The little patient coöperated nicely in this respect and they were able to secure gravity drainage of the pericardium from the start. The

## SOLITARY CYST OF LIVER

wound healed completely in about one month and at the present time the child seems perfectly normal with regard to cardiac function.

Just before her discharge from the hospital (July 20) the following was made: Ventricular rate 132. 1. Auriculo-ventricular tachycardia. 2. "T" is flat in leads I and III and negative in lead II.

This is not a typical record of congenital heart disease. If there is clinical hypertrophy neither ventricle is preponderating. The significance of the changes in the "T" deflections is not proven.

It is interesting to note the prompt and apparently perfect recovery in this case of suppurative pericarditis. Only time will tell whether there will be any trouble, due to adhesions. The postural treatment, without any drainage material in the pericardium, seems to be a step in the direction of avoiding the usual complications.

## SOLITARY CYST OF LIVER

DR. EDWARD W. PETERSON presented a woman, thirty-two years of age, who on March 25, 1922, at 11.30 P.M., was awakened by an attack of severe pain in right upper quadrant of abdomen, pain radiating to left breast. There was no nausea, vomiting, chills or fever, with the initial seizure, nor at any time during the six weeks before he saw the patient. From the time of the attack the patient was never free from pain and got but little sleep, and as she was unable to lie down, she had to secure her rest sitting up. There was much belching of gas when the pain was at its height. The appetite and digestion were poor. Bowels were constipated. Urination was negative. Sixteen pounds loss of weight.

When the patient was first seen by him on May 8th, she was apparently suffering considerable discomfort, walked with the body well to the right. Upon examining the abdomen there was rigidity and tenderness over the whole right side, but it was most marked over the gall-bladder area. No palpable masses could be felt, but the examination was unsatisfactory owing to the right-sided rigidity.

On May 9th, the abdomen was opened through a high right rectus incision. Gall-bladder apparently normal, but pushed upward and outward, by the distention of the under surface of the liver. The right lobe of the liver was enlarged, tense and fluctuating. An aspirating needle was introduced and first a straw-colored and then brownish, hemorrhagic fluid withdrawn. The needle opening was enlarged and a large cavity, holding approximately 600 to 800 c.c. of fluid, was entered. Owing to the free bleeding it did not seem wise to attempt to remove the cyst lining. A large tube was placed in the opening on the upper surface of the liver, and a large double tube was introduced below, just external to the cystic duct, and brought out behind, between the tenth and eleventh ribs, giving through-and-through drainage. The appendix was removed. Following operation there was profuse drainage for the first few days. The patient's temperature ranged from 100° to 105° and did not reach normal until the tenth day. For the first week the

patient was seriously ill, then there was gradual improvement in all symptoms. On the seventh day the anterior drainage was removed. After that the cyst cavity was irrigated daily with Dakin's solution.

An attempt was made about two weeks after the operation to remove the posterior tube, hoping that by this time a sinus would take care of the drainage. Patient felt chilly that night, had pain, cough, and general malaise. As soon as a smaller tube was introduced the unpleasant symptoms disappeared. Patient was discharged from hospital on June 4, 1922. It was not until July 12th that the tube was removed, although it had gradually been shortened, just in order to prevent healing of the external wound. It was late in July before the drainage stopped and the sinus healed.

The cyst fluid which was sent to the laboratory showed fibrin, red cells, and a moderate number of leucocytes and round cells. No parasites or ova were found.

Non-parasitic cysts of the liver are rare and, in 1916, Moschcowitz found only 83 cases in the medical literature. The solitary non-parasitic cyst is found only in women. Bland-Sutton suggests that such a cyst is formed from the dilatation of the bile ducts, which fuse and form the cyst. Simple drainage will usually effect a cure.

#### DETAILS IN THE SUSPENSION AND TRACTION TREATMENT OF FRACTURES

DR. JAMES N. WORCESTER read a paper (with lantern illustrations) with the above title.

To illustrate the paper, he presented a young woman, who on October 20, 1921, slipped and fell, landing on her outstretched left arm. She was put up with Velpeau bandage. X-rays taken showed fracture of the surgical neck of the left humerus with angulation. She was taken to Reconstruction Hospital, October 25th, and was placed in a suspension frame with traction of 10 pounds. It was impossible at first to abduct the arm more than 15 degrees, but with the traction, at the end of three days, the arm was brought out to a position of marked abduction and rotation by increasing the degrees of these positions gradually.

X-rays, November 1, 1921, show almost perfect position at site of fracture. Kept in suspension frame for twenty-nine days. After removal of this the passive motion of the shoulder joint was practically normal in range and the active motion showed only slight limitation of abduction. Returned to work as stenographer day after discharge from the hospital. With exercise and massage complete normal rotation has been regained so that it is impossible now to tell which arm was fractured. This case was shown simply to demonstrate that when this method of treatment is used the long period of disability following the union of the fracture is done away with and the total length of disability very much decreased.

DR. ROYAL WHITMAN limited his comments to the treatment of fracture of the neck of the femur by traction. Possibly the reader did not fully appreciate the fact that the problem of treatment of fractures at the hip was quite different from that of fractures elsewhere. For, since the neck of the femur projected laterally, traction, however efficient in other situations, could at best appose the fragments only in a lateral and therefore insecure relation. It was admitted that what were classed as good results, according to the present standard, might be attained by this or any other method, if the fracture were incomplete or at the base of the neck. The true test was the so-called intracapsular fracture. In this type the fragments were of small area, and as there was no external callus formation, direct repair required a security of exact apposition similar to that for bone grafting.

This could be assured only by the abduction method, in which the fragments brought into a horizontal plane, and therefore end to end, were forced into contact in complete abduction by the tension of the enclosing capsule, a position in which muscular contraction, so difficult to control by external splinting or by traction, could have no influence whatever as an agent of deformity.

Traction by the weight and pulley, however effective in reducing shortening, was a most unreliable means of maintaining apposition. This point was illustrated by several of the lantern slides of fracture of the shafts, in which the fragments were actually separated by excess of tension. This separation, of no consequence where there was such potentiality for repair, would, he believed, preclude union in fracture of the small part of the neck because the fragments rapidly disintegrated unless contact were assured.

He thought there could be no question of the technical superiority of the abduction method as a means of restoring and maintaining the primary essentials of functional repair in all types of fracture at the hip. Furthermore, it had the great practical advantage that it was under single control, in the sense that once properly applied success was not dependent as was any traction method on an intelligent coöperation that could not be assured under ordinary conditions. Finally the treatment had a far wider range of applicability to aged and infirm patients than any method that required dorsal recumbency, since it permitted elevation of the head of the bed and frequent changes from the dorsal to the ventral position, thus preventing hypostatic congestion and bed-sores.

In experienced hands the abduction treatment had become a commonplace routine, including cases formerly thought to be ineligible for any treatment—with a far lower death-rate than from life-saving neglect, and with results that compared favorably with those of other fractures in patients of the same class.

The most constant criticism was that voiced by the reader that "the plaster treatment" was often uncomfortable and unsatisfactory. He would emphasize the point that the abduction treatment was not a plaster treatment.

It was an anatomical method in which the plaster spica served the subsidiary purpose of holding the limb in the attitude that made the internal splinting effective. The plaster spica was the only support at general command, and when properly applied it served its purpose admirably. He concluded that the skill and assiduity required to make an inadequate method effective even in a hospital ward would make the abduction treatment practicable on a comprehensive scale under the conditions to which, in the great majority of cases, the treatment must be adapted.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting Held November 6, 1922*

The President, DR. JOHN H. JOPSON, in the Chair

## CHRONIC EMPYEMA

DR. NORMAN S. ROTHSCHILD presented a woman, aged twenty-four years, who was admitted to the Medico-Chirurgical Hospital, service of Dr. John H. Jopson, January 21, 1922, with the following history:

Had lobar pneumonia three and one-half years ago. Three days after onset, she began to have pleuritic pain. Two days later pus was aspirated from the chest and a rib resection was performed. Drainage tube was pulled out by the patient the next day. Several months later, there was marked purulent discharge from the wound, which has continued up to the present time. A year and a half before admission chest was reopened and it has been draining since that time. When admitted the lung expansion was limited on the left side. Tactile fremitus is greatly diminished on the entire left side. Percussion note is flat—more marked posteriorly. Breath sounds are distant throughout the posterior surface of the left chest and laterally below the level of the fifth rib. No râles heard. There is a sinus at the level of the sixth and seventh ribs posteriorly in the post-axillary line, which is discharging greenish pus, which on examination contained a Gram-positive diplococcus and diphtheroid bacilli.

X-ray examination revealed the entire lower half of the left chest to be of a density sufficient to consolidation, due largely to the pleural thickening, with some exudate. Injection of the sinus reveals a cavity approximately 7 cm. in depth and about 3 cm. in width.

Operation on February 1, 1922, consisted of a resection of the seventh and eighth ribs on the left side. At this time the exploration of the cavity revealed it to extend to the clavicle above and to the eighth rib below. About one quart of pus was evacuated. Dakin tubes were introduced at the time of operation, 75 c.c. of Dakin's solution being injected every two hours during the day and every four hours at night following operation. Six days after Dakinization, twenty-nine organisms per oil immersion field were found. Eight days after Dakinization, twenty-four organisms per oil immersion field were found. Culture of the Dakinized cavity revealed staphylococcus aureus and few diphtheroid bacilli. Seventeen days after operation, nineteen organisms per field were found. A gradual reduction was obtained and on the fifty-ninth day only two per field were observed. Fifty-eight days after operation patient developed a severe dermatitis and Dakinization had to be stopped. Sixty-three days after operation Dakinization was resumed

as dermatitis had somewhat subsided. Capacity of the cavity was ninety cubic centimetres. Smear count was four to a field. Culture from the depth of the wound was negative. Sixty-eight days after operation three organisms per field were found. During this period patient's general health was improving. Temperature was subnormal in the mornings and normal in the afternoons.

On April 25th, eighty-four days after this operation, patient had a hemorrhage into the pleural cavity, which was evidenced by blood-soaked dressings. This was apparently controlled by horse serum. On May 17th, 106 days after the operation, the first stage of the Keller operation was performed under nitrous oxide and ether anæsthesia. A U-shaped incision was made extending from the fourth rib parallel to and behind vertebral border of the scapula, curving down to the eighth rib and then anteriorly to the sixth rib in the anterior axillary line. The fourth, fifth and sixth ribs were resected. (The seventh and eighth had been resected at our first operation.) Muscles attached to the vertebral border of the scapula were severed near their vertebral attachments and were folded and sutured under the skin. The roof of the cavity was completely exposed. Parietal pleura was removed. The cavity was packed and the upper and lower margins of the wound were sutured. Three days later the packing was removed under nitrous oxide anæsthesia. Dakin tubes were inserted. Dakinization was again resumed. Blood count at this time was 3,150,000 red blood cells, 9400 white blood cells, 50 per cent. hæmoglobin. Differential counts showed 50 per cent. polymorphonuclears, 35 per cent. small lymphocytes, 3 per cent. large lymphocytes, 2 per cent. transitionals and 1 per cent. eosinophils.

On June 20th, thirty-four days after the first stage of the Keller operation, smears showed an occasional bacillus and culture showed bacillus pyocyaneus. On June 28th, forty-two days after the first stage, the second stage operation was performed. An incision was made just outside the margin of the granulation tissue of the old wound. The granulation tissue was removed. The skin which had been folded over the muscles of the outer wall of the chest at the first operation was dissected up uncovering them. The visceral pleura was considerably thickened. The cavity was clean and free from pus. Part of the visceral pleura measuring about three by four inches was dissected from the lung. The remainder was incised in criss-cross incisions. The latissimus and other muscles were loosened from the under surface of the scapula and the resulting flap was sutured to the floor of the cavity. The arm was brought to the side and the edges of the wound at the upper and lower ends were approximated with silkworm-gut sutures. A large perforated sheet of rubber dam was placed into the wound and the opening was then packed with gauze, the whole being forced to the bottom of the wound.

Seven days after this operation the dressings were changed and there was considerable greenish, watery discharge from the wound. Eleven days after this operation Dakin tubes were inserted and Dakinization of the wound was begun. From this time the discharge decreased in



amount. On August 2nd, thirty-five days after this operation, tubes were removed. On August 6th patient was discharged from the hospital with very little drainage. Subsequent examination of the patient revealed that the wound is completely closed and that the movement of her left arm, which following the second operation was considerably impaired, is now returning to normal, although she cannot completely elevate the arm. Her general condition is excellent, and there is surprisingly little deformity of the chest visible, following this extensive resection of its wall. She is stout and the considerable amount of subcutaneous adipose tissue conceals to a certain extent the chest collapse. The result leaves little to be desired. It will be noted that in this case the major part of the wound was left open after the second stage operation and muscle implantation. Colonel Keller, operating step by step, according to indications and the patient's resistance, completes his technic by secondary skin suture, the ideal method. In this case such suture was not done and the wound healed by granulation. At the time of this operation we had not had access to the published reports of Keller's work, giving the full details of his admirable technic.

## FRACTURE-DISLOCATION OF LUMBAR VERTEBRÆ

DR. JOHN B. WOLFE presented a man, thirty years of age, born in Austria, immigrated in 1907; father living and well, age sixty, mother died at thirty-six following childbirth; one brother and three sisters living and well. Patient denies previous disease or injury, is married; five children are living and well, the oldest is ten years of age, the youngest born April 11, 1921. Occupation always that of a laborer. He was a moderate user of beer and wine. He was injured March 18, 1921, while loading a car of coal in the mines by a fall of rock, which struck his back, hurled him to the ground, jamming his head forcibly against the mine car with resultant deep laceration of the scalp in the left frontal region; marked shock, undoubtedly augmented by exposure to cold during the two hours required to extricate him, and motor paralysis, which was total and complete from the waist down. He was transported to the hospital, lacerated scalp was sutured and healed without further complications. Primary treatment was directed to shock, which was extreme for forty-eight hours, which seriously threatened the life of the patient and which precluded all thought of surgical interference. An air mattress was employed and every precaution taken to prevent bed-sores—fortunately none developed.

At the end of the first week there was continued total and persistent motor paralysis with loss of reflexes; sensation was impaired but sphincter control maintained. There was a large hæmatoma overlying the site of injury. A rather unsatisfactory X-ray (taken with portable outfit) showed so much vertebral fracturing that any pressure or manipulation was deemed dangerous. Accordingly a Buck's extension was applied to both legs, as much as thirty pounds being used at times with counter-extension to the head. Extension was maintained for eight weeks in the hope of attaining the maximum of reduction, and after the second week improvement in motor function was apparent almost from

day to day; the right leg and thigh responding first, the left more slowly, the peroneal muscle group in each leg being the last to become normal. Passive movements, electricity and massage were instituted after three weeks and a splint used from the outset which maintained the foot at a right angle and prevented stretching of tendons or contractures of muscle groups.

Röntgenological examination on June 3, 1921, showing a crushing fracture of the third and fourth lumbar vertebræ with displacement of fully one-half the width of the vertebra of the caudal end to the right and with anterior displacement of the third lumbar vertebra upon the fourth the depth of the vertebral body. There are also fractures of the lateral processes of the third, fourth and fifth vertebræ, with extensive callus formation especially upon the left side. (Fig. 1.)

Patient was fitted with a brace and began walking on July 1, 1921, and on the 15th walked from the hospital with the aid of a cane. On October 1st there was recovery of power in both legs with, however, a tendency to fatigue, he had practically dispensed with the brace and walked well, being able to do more than a mile before becoming exhausted. During November, he returned to work as "gate-tender" in the breaker and has worked steadily since. At the time of writing (September 26, 1922) color and musculature are good; gait and posture are normal and there is no evidence of paralysis—he swung himself onto a table three feet high for X-ray examination with less apparent effort than the average. There is rather marked lumbar kypho-scoliosis and the site of fracture can be palpated as a bony prominence. He works daily, walking to and from a point one mile from his home and is not especially fatigued at nightfall. Height 5 feet 6 inches; weight 136 pounds; height before injury 5 feet 8 inches; weight 160 pounds. There is fixation of the third, fourth and fifth lumbar vertebræ, otherwise forward, backward and lateral body movements are normal. The knee jerks are still absent. Comparison of X-ray films made September 25, 1922, with those of June, 1921, show marked increase in callus formation, especially in the lateral aspect. The patient's mental attitude is excellent and he notes continued improvement in his condition.

#### VOLKMANN'S CONTRACTURE

DR. JOHN H. JOFSON presented a girl, age nine years, who was brought to the Presbyterian Hospital on September 22, 1922, with a fracture near the elbow-joint. The house surgeon diagnosed it correctly as supra-condyloid, and after an attempted reduction was about to dress it in the Jones' position when he noted that the radial pulse was absent at the wrist in the injured arm. With excellent judgment he admitted her to the ward and applied a Thomas splint, dressing the arm in the straight position with light extension to the forearm and hand. The examination the following day showed moderate swelling of the elbow, the radial pulse still absent, but the circulation in the hand and fingers was good. X-rays showed a supra-condyloid fracture about 1 cm. above the epiphysis, the upper fragment presenting a sharp spine



FIG. 1.—Fracture—dislocation of lumbar vertebrae.



forward, the lower fragment of the joint displaced upward and backward and toward the outer side. Extension was removed and the arm allowed to remain dressed in the suspended Thomas splint. On the second day, circulation still being good in the hand, reduction was attempted under nitrous oxide anæsthesia and the arm dressed on an anterior angular splint. Subsequent X-rays showed no improvement in position. Six days after the accident, the swelling having subsided, open reduction was practiced through an external incision. After reduction the fragments were fixed by one silver wire suture and the arm dressed in flexion in a modified Jones' position. Subsequent X-rays show good correction. About a week after operation it was noted that the wrist and fingers were assuming the characteristic contraction of an ischæmic paralysis. Evidences of nerve injury were lacking, and this was confirmed after careful examination by Dr. Williams Cadwalader, the hospital neurologist. A splint was applied to the hand and forearm, and daily massage was ordered. It is now six weeks since the injury. Union in the fractured bone is complete. There remains some contraction of the flexor muscles of the hand and wrist, which is improving under treatment. The elbow movements are still very limited. There is a firm induration of the muscles on the anterior surface of the forearm and the elbow, which is most pronounced in the flexor and pronator groups in the upper part of the forearm and in the brachialis anticus. The hand and fingers are still supported by a Jones' cock-up splint, and this is removed daily for treatment. The diagnosis is Volkmann's ischæmic paralysis, due to primary brachial artery thrombosis, the result of the injury, and not from the usual cause, namely, tight bandaging. The case is a mild one and the prognosis is favorable for complete recovery.

A very excellent article on this subject by John Jacques Thomas appeared in the *ANNALS OF SURGERY*, March, 1901. Theories advanced up to that time included among its causes arterial obstruction, interference with the return venous circulation, compression, and nerve injury. The last mentioned is regarded by Thomas among others as secondary and contributing, but not a necessary factor. It was present in over one-half of the cases. Tight bandaging is not always a factor. Gibbon has reported one case due to treatment of a fractured elbow in the Jones position. Scudder emphasizes the usual origin of this complication of elbow-joint and forearm fractures as being too great pressure upon the soft parts, causing the characteristic ischæmic myositis. He also admits some cases are due to vessel thrombosis where no splint has been used, and quotes Littlewood to the same effect, the latter including simple extreme swelling of the soft parts and prolonged exposure to severe cold among the exciting factors. As Scudder puts it, "the contracture is the result of prolonged interference with the normal circulation." This is the only case we have seen which was not due to the improper use of splints. It is very clearly due to arterial obstruction, with or without interference, at the same time and from the same cause, with the return venous circulation. The arterial obstruction resulted from the fracture, and not from the after treatment.

## PHILADELPHIA ACADEMY OF SURGERY

### STABILIZATION OF WRIST JOINT BY BONE GRAFT IN SPASTIC PARALYSIS

DR. WILLIAM JACKSON MERRILL exhibited a case of spastic hæmi-plegia involving chiefly the upper left extremity. It is due to a birth injury. The symptoms appeared when the patient first began to use the left arm. The function of this arm has been practically nil and he has carried it in the characteristic position with continuous spasm, increased on any attempt at function. He was subjected to operation January 20, 1920. A graft about two and three-quarters inches in length by about one-quarter to one-half inch in its other dimension was taken from the crest of the tibia to be inserted into the lower end of the radius and into the carpal bones as follows: Incision was made through the skin and subcutaneous tissues in the line of the third metacarpal bone and the mid line of the radius. With a twin saw a groove was cut in the radius and into the carpal bones to receive the graft. The graft was placed in the groove and held in position by a kangaroo tendon. The wrist was dressed in a 45 degree cock-up position and held firmly in that position by a plaster case from the tips of the fingers to the shoulder. The flexor tendons of all of the fingers were completely stretched before the splint was applied. This position was maintained by case for about a year. Substituting the case aluminum metal splints were used for a period of over a year. Subsequently a palmar cock-up splint was worn.

These removable splints were used especially for the purpose of beginning function as well as massage and manipulation. When the arm was carried in its characteristic contracted position the spasm of the flexor muscles of the wrist and fingers seemed to increase the general spasticity of the entire upper extremity, even the deltoid was markedly spastic and the pectorals so markedly contracted that the arm could not be abducted beyond 45 degrees. When the case was removed, the spasticity in the flexor muscles of the fingers was very greatly reduced and the spasticity of the other muscles of the upper extremity was markedly lessened.

Soon after the removal of the splints, after continued massage, manipulation and exercise, the patient began to use the fingers; abduction of the thumb was only about 30 per cent. normal and the extension of the fingers about 80 per cent. of normal.

This range of motion, however, enabled patient to grip objects, tie his tie, lace shoes, hold fork, button coat, and so forth. The stimulus of function seemed to add a great deal to voluntary control also to benefit physically. The improvement continued until function has reached its present range. He now can do practically 70 per cent. of acts in his normal regime, play certain games, even golf, using a left-handed club because of the diminished range of motion of the upper right extremity.

Doctor Merrill said that he had tried arthrodesis on the wrist to stabilize it in the cock-up position but without any great success but with a decided improvement. It occurred to him that if the wrist could be placed in such a position that the extensor muscles of the fingers would have an advantage over the flexor muscles, that they could extend the

## HÆMOLYTIC JAUNDICE

fingers and permit of function and it seems better to gain that function in this manner than to do so by weakening the flexor muscles, thereby diminishing their function. Furthermore, without stabilization of the wrist it was possible again for flexion contracture to take place, which condition seemed to increase the general spasticity. He had also seen marked improvement in spastic contracted wrists and hands after wearing a cock-up splint for several weeks. Naturally when the splint was removed the contracture deformity recurred. The X-ray shows the graft in place and that osteogenesis has been quite active, and the picture indicates that arthrodesis of the wrist and bone graft are capable of holding the hand in its present cock-up position. The wound healed by first intention, the progress of convalescence was unimpaired and the improvement was even more than anticipated.

### HÆMOLYTIC JAUNDICE—TREATED BY BLOOD TRANSFUSIONS

DOCTORS GEORGE M. LAWS AND WILLIAM BATES reported the case of a man, age thirty-six, who, after a series of digestive disturbance extending back some two years, developed severe pleurisy-like pain on the left side. One week later jaundice and weakness began which have steadily progressed, and recently he had had two severe attacks of pain under the right costal margin. Has had an increasing pallor for the past three or four weeks.

The man was a well developed adult who showed some apparent loss of weight, a deep general jaundice, marked scleral jaundice, slight tenderness below each costal margin, and a moderate enlargement of the spleen. Otherwise his physical examination was entirely negative.

On January 31, 1922, he was admitted to the American Hospital for Diseases of the Stomach for observation and treatment. His clinical findings showed a temperature varying from normal to 100° F., a pulse rate varying from 84 to 104, and a respiratory rate of 20. His first blood examination on day after admission showed red blood cells, 1,730,000; white blood cells, 11,200; hæmoglobin, 34 per cent.; a coagulation time of four and three-quarter minutes and a differential of polymorphonuclears 80 per cent., large mononuclears 7 per cent., small mononuclears 12 per cent., and eosinophils 1 per cent.; a negative blood Wassermann and a negative blood culture.

Urine was turbid, yellow, normal odor, specific gravity of 1.015; alkaline reaction; very minute trace of albumen, 0.003 per cent.; absence of glucose, diacetic acid or acetone; a slight excess of indican; a large excess of urosium, and no bile, microscopically there was one hyaline cast, a few squamous epithelial cells, and many shreds with enormous number of triple phosphates.

A gastric analysis—Ewald test meal—36 c.c. removed in one hour, was 50 per cent. solid residue, and was slightly blood tinged. There was a small amount of mucus, a total acidity of 54, a free HCl estimation of 24, and a strongly positive occult blood reaction.

Fæces were also positive for occult blood. X-ray studies were made which showed no pathology of the stomach or duodenum, and no gall-stones.

Dr. O. H. P. Pepper, in consultation, made a diagnosis of hæmolytic jaundice of the acquired or Hayem Widal type as compared with the familial type, and advised blood transfusion at five or six intervals, to be followed by splenectomy if patient's condition improved sufficiently to make the operation reasonably safe.

Eight transfusions were made, seven of them being by the citrate method and by each of these 500 c.c. was injected; the other one was done by the syringe method, and when 30 c.c. had been injected the patient went into shock.

Of the eight donors, all of which were tested by cross-agglutination with the patient's blood, five were direct blood relatives, either brothers or sisters. After none of these five did we have the slightest reaction, and a study of the urine after transfusion showed no erythrocytes, no hæmoglobin, and no bile, except once we had a few red blood cells reported.

Of the other three donors, some reaction followed each transfusion, one of them, previously mentioned, being a severe degree of shock. All three resulted in chills and subsequent rise of temperature. The urine after one of these showed many red blood cells, and after the one leading to shock it showed many red blood cells, considerable hæmoglobin, and some bile for the first time.

The direct result of each one of these transfusions on the cell count was difficult to determine, but at one time the patient was in much better condition than on admission, and the temperature was absolutely normal. At this stage after one more transfusion it was intended to do a splenectomy, but he never again reached a point where it was felt that it could be done with any degree of safety.

During his sojourn in the hospital he had several attacks simulating biliary colic. Repeated examinations of his spleen showed a progressive enlargement during the whole eight weeks. Following one of his transfusions he developed a thrombotic pile, which was exceedingly annoying but apparently not related in any way with his general condition.

On admission there was a complaint of cough which required constant medication, and about twenty-two hours before death he started with an uncontrollable cough which persisted until death.

DR. O. H. PERRY PEPPER said that these cases of hæmolytic anemia merge on the one hand into the familiar group of so-called pernicious anemia, which cases are often not acute or very severe; and on the other hand, into the extremely severe acute hæmolytic anemias which are usually rapidly fatal. It is in this latter group that one especially desires to remove the spleen, for these are the more actively hæmolytic cases. But unfortunately it is in these very cases that transfusion is most likely to be followed by a severe reaction. In other words, the cases which one most wishes to splenectomize are at the same time the cases in which one will have the greatest difficulty with transfusion reactions. The case reported will exemplify this. This case also illustrates the not infrequent occurrence that the early transfusions are followed by no reaction, but after repeated transfusions have been given reactions commence



to appear. The blood of the patient reported showed a higher percentage of young cells than in any other case he had observed, and from this it may perhaps be assumed that the hæmolytic process in this patient was extremely active. This suspicion is borne out by the clinical course of the case.

DR. GEORGE M. DORRANCE said that he was accustomed to make the usual grouping test. He also tested blood against blood and believed this to be the proper method. He had had a similar experience where the question came up of using citrated blood or blood direct. He could not find any difference in this particular case. If anything the citrated blood gave less reaction. Lately he had been interested in seeing if it is true that citrated blood gives more reaction than whole blood. If the transfusion is not large he had not found any difference. In cases of a large amount of transfusion citrated blood gives more reaction. Sometimes he gave one transfusion of whole blood and a few days later a transfusion of citrated blood. He never had any tremendous reactions and he believed it to be largely due to the fact that he used old tubes, boiling them over and over again. New rubber tubes will give reactions constantly.

DR. D. L. DESPARD said that he had had a number of very violent reactions from using the citrated methods, very frequently œdema of the lungs, and in one case convulsions and death. For that reason he had not used the citrated blood method for five or six years. He never gave over five or six hundred c.c. by either of these methods. No reaction followed from the direct blood transfusion, and so had abandoned the citrated method.

DR. JOHN H. JOPSON remarked that Doctor Speese had been doing most of his transfusions by the citrate methods, in the Presbyterian Hospital, and he does not get these violent reactions.

DOCTOR LAWS said that this case report might have been entitled: Failure of blood transfusions to prepare a severe case of hæmolytic jaundice for splenectomy.

They were confronted with a patient who was exceedingly ill and they had very little in the literature to help them to gather information as to what was to be expected from transfusions.

## EMPYEMA THORACIS—ANALYSIS OF TWO HUNDRED AND FIFTY CASES TREATED AT THE CHILDREN'S HOSPITAL OF PHILADELPHIA

DR. HENRY P. BROWN, JR., read a paper with the above title.

DR. A. P. C. ASHHURST said that it was his conviction, based largely on the studies of Dr. T. Turner Thomas, that drainage should be made at the most dependent point in the cavity. While he did not go as far as Doctor Thomas does in resecting the eleventh rib invariably, yet he does do so in some cases. Usually he selects the tenth or the ninth, and not in the posterior axillary line, but at a point much nearer the spinal column. The angle of the scapula normally comes down over the eighth rib in the posterior axillary line, and though one may draw the scapula up by elevating the arm during the operation, yet if one drains as high as the eighth rib, the scapula will come down to its normal

site after the operation, and interfere with direct drainage. Moreover, even if the scapula were absent drainage at the level of the eighth rib is not low enough in the pleural cavity.

DR. EDWARD B. HODGE spoke of the various types of infection, for this, he believed, is an important point. The streptococcic cases do much better if aspirated several times, postponing formal drainage until they have recovered from their pneumonia, and until adhesions have had a chance to form, then either intercostal incisions or rib resection may be done, as indicated. The pneumococcic cases are not generally as ill and the adhesions form earlier, so that preliminary aspiration is not as important or necessary, and usually primary rib resection has been the procedure.

He made his incision posteriorly at the angle of the scapula and as low down as the aspirating needle reveals pus, always bearing in mind that the diaphragm comes up higher in children than in adults.

DR. T. TURNER THOMAS, referring to dependent drainage, recalled that years ago, the elder Doctor Ashhurst put in a sound, felt the tip of the sound below and cut down on it. A recent English writer thinks the best place for drainage opening is about the sixth or seventh rib because it is opposite the deepest part of the empyema cavity and therefore the last to be filled in by the expanding lung. Doctor Thomas thought, however, that the lung is driven away from the chest wall and its expansion denied by atmospheric pressure, and that the last portion of the lung to reach full expansion is that opposite the opening in the chest wall because the atmospheric pressure is most effective there. When the drainage opening is down at the bottom and atmospheric pressure acts best there, keeping the lung and the diaphragm away from the opening until it is ready to close.

DR. JOHN B. ROBERTS said that he long ago came to the conclusion that no statistics are worth while if obtained from several operators in a hospital unless they all use the same technic. It is waste of time for good men like Doctor Brown to look up old records; almost every operator lets the after-treatment go to someone else. This invalidates statistics. If one takes 100 cases of operations by one man and has him look after his own patients, the conclusions are worthy of belief. He did not think much of statistics obtained otherwise.

A very large number of empyema cases in adults and children need no serious operation; though the quality and variety of the bacteria make a difference in the disease. He thought that quick incision under local anæsthesia, without resection of the rib, drainage by a tube and good care afterward is the treatment. He uses daily irrigation when the temperature goes up a day or two after the operation. The tube should be gradually shortened and not left in for too long a period.

DR. JOHN H. JOPSON said that Doctor Brown had brought out and emphasized the choice between intercostal incision and rib resection; his statistics distinctly favor the latter operation. While this may seem a trifling difference it is not so. For years Doctor Jopson had followed the work of those of his

colleagues who used an incision only, and he had been impressed by the number of cases requiring secondary operations. He remembered the time when Dr. John Ashhurst, Jr., made two incisions with through-and-through drainage, a different method entirely.

As to the use of Dakin's solution in children, his experience in young children has been that the method is poorly borne. He had found that after the use of Dakin's solution one finds that the child is just "not doing well;" there is a loss of physical strength and a deterioration, the cause of which is difficult to determine. He did not know whether this was due to the repeated irrigation or to some hypersusceptibility to the chlorine solution. Lilienthal mentions having made the same observation.

DR. D. L. DESPARD remarked in regard to the place of incision, one should bear in mind that the object is drainage, and that it should be theoretically at the most dependent point. Most surgeons lose sight of the fact that when the chest is open the diaphragm ascends. He had seen more than one case where the incision had opened up the pleural surfaces which while sealed did not contain pus. He does not think it makes any difference whether one resects or makes an intercostal incision. In the use of Dakin's solution, he had found it very difficult for a nurse with a number of other patients to take care of, to do the Dakinization properly, until a chart was devised which shows in graphic lines the number of bacteria per day, and which also has a space in which the nurse was required to put down the hour in which the irrigation was performed. Since the installation of these charts he had not had any trouble. This was a fairer way to test its use and they have gotten much better results by using it.

DR. J. S. RODMAN emphasized the importance of the bacterial study; the streptococcic cases do better under aspiration, at first, followed by adequate drainage. The pneumococcic cases recovered with almost any type of treatment. As to Dakin's solution, the use of this solution greatly improved the results both as to mortality and morbidity. It is highly important that it be used with the Carrel technic in order that it be brought into contact with all parts of the cavity. In fact in using Dakin's solution anywhere it is essential to remember the necessity of three things—time, concentration and contact. In other words, if a septic cavity is to be sterilized the solution in proper concentration must be brought into contact with all parts of the cavity, at regular intervals. No one who has taken the trouble to use Dakin's solution properly in these cases can fail to be impressed with its rapid bactericidal and solvent properties. With no other method had he seen these cases clear up so quickly, and cases sterilized with Dakin's solution presented almost normally expanding lungs instead of the rigid fixed ones so commonly seen when drainage alone is used.

## CORRESPONDENCE

### SPIRAL FRACTURES

EDITOR ANNALS OF SURGERY:

Sir:

I have but recently discovered a rather serious error in my paper on "Spiral Fractures," which appeared in the ANNALS OF SURGERY in October, 1921, and am writing to ask that in some number of the ANNALS, the following corrections be made and appear in the index: *Page 492, line 8*, the first word "*right-handed*" should be "*left-handed*" and in *line 9*, the word "*left-handed*" should be "*right-handed*"; *line 19*, the first of the words "*left-handed*" should be "*right-handed*" and in *line 20*, the word "*right-handed*" should be "*left-handed*."

I hasten to say that the error did not occur on your part, but on mine, in transcribing from one copy to another, it somehow escaped rather careful proof-reading.

I am asking that this correction be made as far as any such correction can be made, because of its importance. Although if anyone were to read the article critically, he would appreciate that the statements referred to above were clerical errors.

Very respectfully,

EMMET RIXFORD, M.D.,  
*San Francisco, Calif.*

## HYPERTHYROIDISM WITH ASSOCIATED DIABETES MELLITUS

EDITOR ANNALS OF SURGERY:

Sir:

The opportunity was recently afforded us of studying a patient suffering from hyperthyroidism with a complicating diabetes mellitus. Much has recently appeared in the literature tending to give the impression that this is not an unusual finding, but such has not been our experience. In the one hundred patients with hyperthyroidism immediately preceding this one no evidence of a true diabetes mellitus was found. The interest in our case lies in the association of two distinct clinical entities in the same individual, the comparative safety of early operative interference, and the effect of modern treatment on diabetes mellitus when a complicating hyperthyroidism is removed.

*Report of Case.*—History.—Case 13045. Mrs. H., aged fifty-five, came to the Clinic complaining of headache, painful swelling of the neck and frequent urination. Her family history showed her mother died of diabetes at forty-four. The patient had always been in robust health (except for nocturia for the last nine years) but since the summer of 1921 had suffered from chronic headache. Since December of that year, there had been a painful, progressive enlargement of the neck. Since January, 1922, she believed she was passing a larger amount of urine than normal and that her thirst and appetite were greatly increased. At

the time of examination she was easily fatigued and sleep no longer rested her. June, 1921, she weighed 245 pounds, in March, 1922, 188.

The patient was a large fat woman, apparently fifty, of healthy appearance and showing no evidence of loss of weight. There was no exophthalmos, and the ocular muscles and fundi were normal. The tendon reflexes were uniformly exaggerated and there was a fine tremor of the extended fingers. Neck examination revealed a large, smooth, firm thyroid. The right lobe was very prominent, the isthmus easily palpated, and the left lobe flat and lobulated. The blood-pressure was 152, systolic; and 110, diastolic; pulse rate varied from 84 to 96, and the temperature was slightly elevated. Dermographia was marked and both palms and soles were hyperidrotic. Physical examination elsewhere was negative.

*Laboratory Findings.*—On admission to the hospital (March 27, 1922) a twenty-four-hour urine specimen revealed:

Amount .....	2010 m.
Specific gravity .....	1.042
Glucose .....	6.5 per cent.
Albumin .....	a trace
Casts .....	hyaline and granular
Acetone and diacetic acid++	

Blood examination:

Fasting blood-sugar .....	0.44 per cent.
Non-protein nitrogen .....	36.2 per cent.
Uric acid .....	2.65 mgs.
Urea nitrogen .....	14.00 mgs.
Chlorides .....	.525 per cent.
Hæmoglobin .....	90. per cent.
Red cells .....	4,800,000
White cells .....	9,200

Basal metabolic rate was +49.5.

*Subsequent Course.*—From March 27th to April 10th the patient was gradually de-sugarized by Joslin's method. She responded so well to this regimen that it was not necessary to reduce the diet below one thousand calories per diem. On April 13th the blood sugar was .19; the urine was sugar and acetone free, and the basal metabolism was +40. The next day the thyroid was removed under local anæsthesia and after an uneventful recovery the patient left the hospital May 2nd. Treatment was continued under Joslin's plan, but due to her apprehension over continued loss of weight (188 to 150 pounds), her diet was arranged to conform with Woodyat's formula in June. This modification gave her:

Carbohydrates .....	38.32 gms.
Protein .....	89.98 gms.
Fat .....	214.75 gms.
Calories .....	2,457

The patient has continued on this diet up to the present, is maintaining weight and is in excellent general condition.

DRS. WILLIAM COLE AND IRWIN C. SUTTON,  
The Johnson-Wickett Clinic,  
Anaheim, Calif.

# GASTRO-JEJUNOSTOMY FOR PERFORATED GASTRIC AND DUODENAL ULCERS

EDITOR ANNALS OF SURGERY:

Sir:

I wish to mention that personal (including some unpleasant), experience convinced me, years ago, that the operation for closure of the perforation does not, *per se*, cure the ulcer, and forced me to adopt the following routine:

(I) Seal the perforation *as quickly as possible*. Keep the patient in bed for one month on milk and mist-carbonatis *ter die*.

(II) Then perform, when feasible posterior, gastro-jejunostomy. Again keep the patient in bed on milk and mixture of bismuth, soda and magnesia for a further thirty days.

(III) Follow, for ensuing month, with a pap dietary, emphasizing the necessity for slow and deliberate mastication. Before leaving your charge present the patient with a menu of careful "gradual" feeding for the following year. Add as postscript never retain a carious tooth or pus bag in your jaw.

It is my firm belief that if, in cases of ulcer treated by gastro-enterostomy, one were to adhere to thirty days' rest of stomach and body, followed by intelligent feeding for one year and then switched on to a permanent plan of dietary, etc., as sketched in my essay "Gastro-enterostomy and Some Dietetic Rules," *British Medical Journal*, February 25, 1922, we should hear much more about the virtue of gastro-jejunostomy, and a great deal less about the necessity for gastrectomy, which, by the way, substitutes another sore which has to be dealt with by the natural factors of repair, and which, I find, sometimes passes into the condition of chronic ulceration ending up in cancer.

The fact must not be ignored that the human cells have got to do the healing, and given the general feeble power of repair which obviously must exist in every one who possesses a chronic ulcer of the stomach, is there any reason to assume that the chances excluding operative shock, etc., of cure are enhanced by the substitution of a huge acute wound for a small chronic one which at one time, originated in a small acute lesion?

These remarks apply to operations performed with the aid of a sharp knife in observance of the rudimentary natural law, the sharper the knife, the cleaner the cut and the more rapid the healing.

Recently some, who only see through diathermic spectacles and who evidently have not taken the moral to heart "He was well, he wanted to be better, he took medicine and he died," have been booming excision of *all* gastric ulcers by fire irons. I confess the mere thought of a deep "burnt" wound, with its physiological aftermath plus cancer potentiality in a stomach wall compels me to cling to an accustomed rule, in surgery exorcise the logic of the tinker.

At one period I went in for excision of "everything," even some chronic ulcers of leg. This extension of surgery soon ceased, as I frequently found that, instead, I had obtained a chronic one of double the size.

Continuing this simile, I beg my readers carefully to compare the rational treatment for the cure of an ulcer of leg, *viz.*, absolute rest with limb elevated on a suitable back splint and soothing aseptic medication until the sore has healed with what one now reads of as all the rage for the cure of an ulcer of the stomach after gastric operation, early administration of solid food "to buck him up," early out of bed, "to keep his blood moving. Archaic to reflect as to what "the sappers" may think of peristalsis and food stuff, contempt in general for the term rest and everything possible vouchsafed to render the application of physiology, and the rationale, for the operation, short circuit, a perfect farce.

I do not wish it to be inferred that in cases of ulcer surrounded with enormous induration, *probably* beyond power of resolution—much less in cases in which there exists a *reasonable* suspicion of cancer—that I advocate gastro-enterostomy instead of gastrectomy, but I do maintain that when the latter is essential the former should be added plus an after-treatment which will correspond to the natural law of repair.

SIR JOHN O'CONOR, M.D.,  
*Buenos Aires, Argentina.*

P. S.—Since the above was sent for publication I have learned, from *Ochsner's Surgery*, 1922, the source from whence sprang the idea that the operation for closure of a perforating gastric ulcer cured this lesion. I can only reiterate that I have treated cases in which the symptoms afterwards became as accentuated as before, and which posterior gastro-jejunostomy without loop, which, by the way, I have exclusively practised, without clamps and without a single instance of peptic ulcer intervening for twenty years, followed by common sense rest—cured the patients.

Recently I have known of a sad fatality in which the secondary treatment was neglected.

Until I had read above edition I was unaware of the proportion that charring (to 6th degree) of the stomach wall had assumed in certain quarters. I am unable to reconcile myself to the creed that such a practice is worthy of the term surgery or physiology—in my opinion it is a mockery of both in that it is opposed to the laws which favor the restitution of normal tissue—a factor which must be seriously contemplated when one operates on the debilitated stomach wall of a devitalized (gastric ulcer) subject.

I cannot but think that sooner or later this stunt will render its dividend of remorse to those who perpetrate an act on a hidden stomach wall which would be considered penal if performed for ulcer on an exposed surface of the human body.

If the patient's power of repair is capable of eliminating the eschar produced by such a burn, it affords proof that, given the ordinary surgical treat-

## CORRESPONDENCE

ment above advocated, the ulcer would have healed, the induration would have disappeared and that gastrectomy by fire irons was an added insult to the natural process of cure.

As before mentioned, if, when the part is exposed, one conscientiously and after deliberate examination, concludes that cancer is probable, hesitation should cease and a free excision should be made of stomach well wide of the involved zone, and as anything is justifiable in cancer, said excision can be made by a cautery, or by any other method which will tend towards rapidity in execution and prevention of hemorrhage in a patient who is, alas, already "half dead."

But on an off chance to sizzle around the circumference of a mass, which if cancerous possesses cells which rapidly permeate by the lymphatics, in the hope that such circumscribed mutilation of everything will check the advance of cancerous cell migration is, in my humble opinion, an unworthy performance.

I tremble to think of the potential elements ultimately attending a "burnt" cicatrix in the mucous coat of a stomach which is unable to resist ulceration following a small infarct.

### To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

### **ANNALS of SURGERY**

**227-231 S. 6th Street**

**Philadelphia, Penna.**



# ANNALS *of* SURGERY

VOL. LXXVII

MARCH, 1923

No. 3

## GENERAL PLASTIC SURGERY\*

By JOHN STAIGE DAVIS, M.D.

OF BALTIMORE, MD.

THE title "General Plastic Surgery" is used because I desire to impress upon the association the fact that plastic surgery should be visualized and taught as a whole, and not be thought of from the viewpoint of any of its subdivisions. Considerable misapprehension exists as to the scope of plastic surgery, the training necessary to do this work properly, and the type of man who can do it best. I hope that the following remarks will make these points clear:

Plastic surgery is that branch of general surgery which deals with the repair of defects and malformations, whether congenital or acquired, and with the restoration of function and improvement of appearance. Its field extends from the top of the head to the bottom of the foot, and the deformities dealt with, in most instances, involve the skin and adjacent soft parts and sometimes the framework (especially of the face) supporting these parts.

During the World War (1914-1918) plastic surgery was arbitrarily limited by military regulation to maxillo-facial reconstruction, and it is my opinion that this was a great mistake, and showed a profound lack of knowledge of its scope. Facial plastic and oral surgery is a very important part of the subject, but I wish to emphasize that it is only a part of plastic surgery and that plastic surgery of the trunk and extremities is as necessary and equally as important. The results may be less spectacular, but they are just as vital to the patient. For a number of years, as I have become more and more familiar with the intricacies of the subject, I have urged that plastic surgery be split from the general surgical tree and made to rank with such branches as orthopaedic surgery or genito-urinary surgery. It has been difficult to convince the "powers that be" of the necessity of this, but the great popular interest in the subject during the war, and the fact that surgeons had to be specially trained in order to give the best results to wounded men requiring reconstructive work on the face, has had some effect, even on the most hidebound.

Plastic problems of the trunk and extremities differ materially from those of the face, and also require special study. When therefore it is realized that there is as much plastic work necessary to be done on these parts as on the

\* Read before the Southern Surgical Association, Memphis, December 12, 1922.

face, it must be admitted by the ultra-conservative that the whole subject is one which demands special consideration. I have heard the remark "that now the war is over there will be no more plastic cases and no more use for plastic surgeons." This, of course, is simply an example of the general ignorance of plastic conditions, as there are always a great many cases in civil practice which require the special care of the plastic surgeon. For the most part they are old defects caused by disease, trauma, burns and necessarily mutilating operations, and also certain congenital malformations.

When the World War began, with the exception of the late H. Morestin in France, and one or two others elsewhere, there were no trained and thoroughly competent *general plastic surgeons*. I use this term to distinguish the few surgeons who have given special attention to plastic problems of the entire body, from those who have confined their plastic work to facial reconstruction of one sort or another. There are comparatively few men at the present time who could fully qualify under this term. However, I hope that within the next few years there will be a trained general plastic surgeon in every great hospital, who is capable of dealing with the plastic problems of the trunk and extremities as well as those of the face.

When men requiring maxillo-facial reconstruction began to come in from the front and were referred to the "head section," it was soon found that there were no surgeons available who knew what to do for them. Therefore certain men were assigned to this special branch, many of whom had previously confined their practice to eye, ear, nose or throat surgery, or to dental work. The majority of them, I venture to say, had never done a plastic operation before the war began, and few had had a general surgical training. In consequence they knew nothing whatever of the subject, even from a surgical standpoint, so had to begin from the beginning, trying out and discarding method after method, until they found procedures which were practical. The opportunity of taking care of great numbers of facial defects during this time, developed a number of extremely skilful and able men in this branch of plastic surgery, and they have done magnificent work. Few of them knew even its principles to begin with, so of course had little knowledge of the literature of the subject. In consequence, discoveries and new methods have been reported, many of which are either modifications of some well-known method, or rediscoveries of methods long familiar to the general plastic surgeon. As a matter of fact, in spite of the vast amount of material available, there have been remarkably few really brand-new methods developed in plastic surgery during the war, except in the treatment of those defects associated with fractures and loss of substance of the jaws. In the care of these cases it was soon found that the coöperation of the skilled dental surgeon was essential. The true plastic problems in military surgery were found to be much the same as those which had been solved in civil practice.

I am struck each time I go through the wards of any large hospital by the fact that there are cases on every surgical service, both general and special,

which require the help and knowledge of the general plastic surgeon. These cases in the majority of instances are simply being carried along. I feel sure that the chiefs of the various services in every hospital would welcome the help of the general plastic surgeon and his organization, as soon as they realized what could be done for these difficult and trying cases, or at least they would be glad to "pass the buck" to the plastic service.

In the military service, in time of war, it seems to me that all cases requiring plastic work, irrespective of the location of the lesion, should be placed in hospitals established especially for general plastic surgery. If this could not be done, then the most effective way of taking care of these cases would be to have a general plastic service in every general hospital, under a properly trained man, to which all plastic cases should be transferred, regardless of the service on which they were originally admitted. I can say from my personal experience that there is very little likelihood of encroaching on other surgical fields. The majority of cases which come to me are referred, either by general surgeons, orthopædic or genito-urinary surgeons, ophthalmologists, rhinotolaryngologists, obstetricians and dermatologists. Sometimes the gynecologist will also ask for help in cases in which the transplantations are of a type with which he is unfamiliar. So it can easily be seen that plastic surgery, instead of taking away something that the other branches want, is simply helping them out, and closing a gap in the art and science of surgery hitherto unfilled.

Proficiency in plastic surgery, like every other special branch of surgery, can only be obtained by long and varied experience, and there is no short cut possible, although much time can be saved by proper instruction. In fact, this branch is particularly tedious as the results in many cases are obtained only after numerous operations, extending over long periods of time.

The teaching of this important subject has been neglected everywhere, and there is as yet, as far as I know, no department equipped for the proper instruction of plastic surgery as a whole, in any American or foreign university. In fact, in many class "A" medical schools the subject is hardly mentioned, if at all, in the surgical course. The ignorance of the profession at large as to the scope and possibilities of plastic surgery is appalling, and no medical school has the right to graduate doctors without some instruction in this subject.

How is the best way to go about the teaching of plastic surgery? My experience when dealing with students is to carry out a program somewhat as follows: During the third year, give a short series of lectures, which in a general way will cover the entire subject. This is best done with the assistance of numerous lantern slides to illustrate plastic problems and the procedures used to solve them. Didactic lectures in surgery are of little value as a rule, but the excuse for this series is that it will show the students the scope of plastic surgery as a whole, and give them an opportunity of knowing what can be done in this field. During the fourth year, plastic surgery should be given as an elective course, and those interested in the

subject should be given every facility in the plastic clinic of the out-patient department to study the treatment of wounds, and carry out the various simple plastic procedures which can be done there. During this trimester the fundamentals of plastic surgery should be systematically taken up by means of conferences and demonstrations on patients. All the cases which require hospital treatment, and which are admitted through the plastic clinic, should be carefully examined, the possibilities discussed and the methods of treatment explained. When these cases come to operation, the students should be present, and should be able to follow the after-treatment in the wards. Even the little the students get in the elective trimester is of great advantage to them in whatever branch of work they subsequently take up, as they seem to absorb something which is lacking in the other surgical courses. I say this advisedly, as many of the men who have taken this course tell me that it has been of the greatest help to them in their work after graduation. An adequate number of ward beds in the hospital should be assigned for the plastic service, and as many house officers as are needed. These house officers should be selected from graduates of class "A" schools, who are interested in the subject. They should assist in the operating room on plastic cases, and in due time should be given operative work under supervision. They should look after all plastic cases in the hospital, conducting the post-operative treatment and dressings under the personal direction of the plastic surgeon in charge. The house officers should also serve in the plastic clinic of the out-patient department.

A service of this kind would be of great use to a man going into other branches of surgery, as it would give him a point of view, and a knowledge of the shifting and handling of tissues, and of the treatment of wounds, which at present is unavailable elsewhere.

It is now a generally accepted fact that "an adequate practical training in the principles and practice of general surgery" is necessary as a preparation for any real surgical specialty. This is particularly important for one who desires to specialize in plastic surgery, and consequently makes its final teaching a post-graduate subject. Post-graduate students should be carefully picked, and only those who show special aptitude for the work should be allowed to take the course, as it is impossible to make a plastic surgeon out of a man who has no flair for it. The post-graduate student should have the opportunity of working in the out-patient department, the privilege of the operative clinic, with the expectation of assisting the operator and receiving personal instruction in operative technic, and eventually be allowed to operate under the eye of the chief. He should have the privilege of following the cases in the wards and of studying post-operative treatment, and the chance for clinical and experimental research on plastic problems. He should have the facilities to study the pathological material removed at operation. Men of special ability should be taken into the house on the plastic service, and be given every opportunity to develop. The course should be at least one year, and preferably two. Instruction in plastic surgery on the cadaver,

except for anatomical relationship, is of little value unless the student understands the circulation of flaps, the behavior of scar infiltrated tissue, and the various problems of skin, fat, fascia, bone and cartilage transplantation.

Operative work in plastic surgery is of great importance, as it is in every branch of surgery, and should be carefully taught. However, in this work too much emphasis can not be laid on the cultivation of sound surgical judgment, and on the importance of careful examination and study of the various possibilities and procedures which may be beneficial in each individual case, as it is seldom that we find two cases exactly alike in plastic surgery. An unnecessary or ill-considered operation may completely eliminate the chance of good ultimate result, and it is the ultimate result we must plan for, and not the immediate relief of the condition. I have seen, and I am sure that many who hear this have also seen, plastic operations done by splendid general surgeons, which seemed perfect when they left the table, but those of us who have been able to follow some of these cases afterwards can tell of complete failures, and the suffering and prolonged convalescence of the patients, and of resulting conditions even worse than before operation. This can be accounted for in many instances by the lack of judgment and training in plastic problems, and by the desire to do too much at one time. When such cases do finally drift to the plastic surgeon, he is terribly handicapped by the fact that all the tissues which might have been used to advantage have been wasted, and by the lowered resistance of the patient. I know whereof I speak, for many of these cases come to me, and I have even witnessed the original operation on some of them, and felt sure when it was done that it would be a failure.

I do not want you to understand from what I have said that the plastic surgeon always gets a perfect result, as the man who never has a failure in any branch of surgery, either does no work, or stretches the truth. I do insist, however, that these difficult problems can best be solved by the trained plastic surgeon.

The knowledge of how to care for large unhealed defects and how to prepare them for contemplated plastic work is very important, although it has been said by those who should know better, that the treatment of wounds is a waste of time for the plastic surgeon and is out of his field. Of vast importance also is the proper preparation of scar infiltrated tissues, and the encouragement of nature, our greatest ally, to give us her generous help to a greater degree than usual, as attention to these details will often materially change the entire aspect of a plastic problem, and give us a better result than could have been anticipated.

In addition to his other qualifications the plastic surgeon must have originality and infinite patience; he must be an optimist, and more or less of an idealist, and he must have a far vision. He must also have a full measure of sympathy, as there is no branch of surgery, except possibly orthopædics, in which patient and surgeon come into such intimate contact over such long

periods of time as in plastic surgery, and in which the personal element enters so much.

Until some such plan as I suggest is adopted, patients requiring plastic work cannot be given the best treatment, and little real progress will be made in the development of the subject. It will take years of plodding, as it has in the past, for those interested to get the fundamentals of plastic surgery, while these can be taught in a reasonably short time in institutions properly equipped for the purpose. I wish to reiterate that there is a crying need for a general plastic surgeon in every large hospital, and also for the comprehensive teaching of plastic surgery in the medical schools. I feel this is bound to come. The question is, which school will see the light first, and start such a course under the direction of a trained general plastic surgeon and provide him with every facility necessary to develop and teach this important and fascinating subject.

## THE TREATMENT OF ANTHRAX INFECTIONS\*

BY ALEXIUS MCGLANNAN, M.D.

OF BALTIMORE, MD.

ANTHRAX forms a small but distinct professional risk to workers in hair and bristles. (.296 and .029 per cent., respectively, Page, *Journal of Hygiene*, vol. ix, 1909, p. 396.) It is also found occasionally among those people whose occupation brings them into direct contact with living or dead animals. It has come into prominence lately because of the danger of its dissemination through the use of infected brushes.

The serious and often fatal disease is quite common among animals, except in those countries where special precautions are taken to prevent the spread of the disease and to secure proper disposal of infected carcasses. One of the many brilliant results of Pasteur's work lives in the relative freedom from the disease existing among the animals of France. From the animals infection reaches man by way of the highly resistant spores which contaminate the crude hides and hair of commerce, as well as the carcasses of animals dead from the disease. Infection may be carried by the worker in one of these industries to individuals not otherwise exposed.

The usual portal of entry in human beings is through an injury to the epidermis. In one type, the wool sorter's disease, infection takes place by inhalation of the bacteria; and there is an intestinal type in which it is probable that the food is contaminated with the spores, most likely from dirty hands. My experience is limited to cases of cutaneous anthrax.

The skin lesion begins as an insignificant wound or abrasion through which infection occurs. A period of incubation, varying in length from a few hours to three days, is followed by local burning or itching and the development of a papule having a bluish-green centre. This lesion and the symptoms resemble those following an insect bite. The papule soon becomes vesiculated, the contents of the vesicle being hemorrhagic or serous. The vesicle breaks down and forms an erosion in which a purplish black area of leathery necrosis is set into the papule and separated from the red indurated rim of the lesion.

The anthrax papule and pustule is relatively painless, a feature which distinguishes it from furuncle and carbuncle.

The transition from the primary papule to the malignant pustule may occur in a few hours, or it may be possible to separate the progress of the lesion into three stages, which occupy from four to six days for complete development. (Graham and Detweiler, *J.A.M.A.*, March 9, 1918, vol. lxx, p. 671.) (Lecene, *Precis de Path. Chirurg.*, vol. I, p. 101, Masson & Cie, Paris, 1920.)

1. The period of incubation lasting from two to three days.

---

\* Read before the Southern Surgical Association, Memphis, Tenn., December, 1922.

2. The development of the papule and vesicle, lasting from twenty-four to thirty hours.

3. The stage of central necrosis with local induration, circumscribed oedema and vesiculation, lasting from one to three days.

In man usually there is a vigorous local reaction to the infection which may result in a distinct tendency for anthrax to remain localized. In rare instances after ten days, spontaneous demarcation and sloughing of the gangrenous pustule may occur, leaving an ulcer which heals slowly.

Often oedema develops about the pustule and spreads rapidly. The extent of oedema depends largely on the character of the tissues in the neighborhood of the primary lesion, and usually resembles a diffuse cellulitis with many blisters on the surface. The lymphatic vessels are inflamed and the draining lymph-nodes become swollen and indurated. The development of a localized pustule indicates a degree of resistance to the bacteria while a widespread oedema is evidence of failure of the tissue to prevent the advance of the infection. However, the bacteria may pass directly from the pustule into the blood and give rise to a septicæmia.

There is some controversy regarding the immediate effects of anthrax inoculation. Hiss and Zinsser (Text Book of Bacteriology, New York, 1916) inoculated the tails and ears of guinea pigs and were unable to prevent general infection by immediate amputation. The observers conclude from these and other experiments that, although the bacilli are not demonstrable in the blood until just before death, they nevertheless invade the blood and lymph streams immediately after inoculation and are conveyed by them to all the organs. The bacilli proliferate at the point of inoculation and probably in the organs until the resistance of the infected animal is entirely overcome. At this time the bacilli are able to grow in the blood stream.

Other experimenters contend that cutaneous anthrax always begins as a local infection with the bacteria confined to the lesion or its immediate vicinity. The clinical course of many cases, particularly those showing an indurated pustule with little or no surrounding oedema, is evidence in opposition to the conclusions of Hiss and Zinsser. There may be some essential difference in reaction to various methods of inoculation, as there certainly is a difference in the susceptibility of various animals.

The method of action of the anthrax bacillus in the body is not as yet definitely known. Hiss and Zinsser suggest that death is brought about to a large extent by purely mechanical means, such as capillary obstruction. Boidin is credited by Lecene with having extracted from anthrax bacilli an endotoxin capable of producing local oedema when injected into animals. Hiss and Zinsser assert that neither a true secretory nor an endotoxin has been demonstrated for the anthrax bacillus, but admit that the clinical picture of the disease makes it impossible to conclude that such a poison does not exist.

Whether or not the disease is localized or general at its onset has an important bearing on the rational method of treating the patient. If there is a recognizable period in which the bacteria are confined at the point of inocula-



tion, complete excision of the primary focus during this period is the surest and most rapid method of preventing general infection. If on the other hand, the bacteria spread throughout the circulation at the moment of inoculation, systemic treatment by specific serum injection is the proper method.†

If the number of bacteria reaching the circulation is small and the active proliferation is limited to the region of the portal of entry, excision of this primary focus combined with injection of the serum into the blood appears to be a reasonable method of combating the disease at the time such relation of infection and resistance exists.

When extensive œdema, lymphatic enlargement and symptoms of general infection have developed serum therapy alone is indicated. At this stage of the disease nothing can be gained by excision of the primary focus, and much harm may be done by opening new avenues for extension by cutting into the infected area.

I have had opportunity to treat six cases of anthrax. All the patients recovered. In four the lesions were distinctly localized, in a fifth there was spreading œdema, and in the other case there were symptoms of general infection. All were cases of industrial anthrax. The credit for the good results obtained is due to Dr. Asa Wessels, physician to the factory, who recognized the lesions as soon as he saw the patients and promptly sent them for treatment. In all cases the anthrax bacillus was demonstrated in the lesion.

Regan (*Amer. Jour. Med. Sciences*, September, 1921, vol. clxii, p. 406) advises the use of the Eichhorn serum both locally and intravenously to the exclusion of all other forms of treatment. His reasoning is good and he shows the effectiveness of the method in the hands of Symmers and others. It may be that with the existing uncertainty regarding the mode of invasion by the bacillus, local and general serum therapy is the best means of treatment, although the good results obtained in our small series of cases seem to indicate the value of early, complete excision of accessible primary foci.

*Case Reports.*—CASE I.—August, 1909. Circumscribed pustule on right arm. The patient was a white man, age forty. The primary smarting and vesicle were noted about forty-eight hours before he reported to the physician. The pustule was about three-eighths of an inch in diameter with a black centre and an indurated narrow red border. Anthrax bacilli shown on the cover slip. There was no swelling or tenderness of the lymph glands and no lymphangitis. Temperature was normal. Under ether the involved area was excised and the wound was left wide open. The patient returned to work in thirty-seven days.

CASE II.—June, 1912. Circumscribed pustule on neck. The patient was a white man, age fifty-two. The lesion was nearly three days old when he reported for treatment. The pustule was about half an inch in diameter, with typical dark centre and red rim. Anthrax bacilli demonstrated in smear. There were no signs of lymphatic involvement, and no fever. Under ether the involved area was excised with the electric cautery. The patient returned to work in thirty-six days.

---

† Eichhorn, of the U. S. Bureau of Animal Industry, has developed a serum of great potency. Serum prepared by his method is now available through the commercial manufacturers.

CASE III.—June, 1920. Circumscribed pustule right forearm. The patient was a white female, age thirty-five. The lesion had been present four days at the time of treatment. It was a typical circumscribed malignant pustule and the bacilli were recognized in the smear. There was no œdema about the pustule, and no evidence of lymphatic involvement. The temperature was normal. Under nitrous oxide the lesion was excised with the cautery. The patient recovered without any complication.

CASE IV.—April, 1922. Circumscribed papulo-pustule on left arm. The patient was a white female, age sixteen. The lesion was three days old at the time of admission to the hospital. The eroded vesicle at the summit of the papule showed an area of dark necrosis about the size of a pin head. The bacilli were recovered from the lesion. There were no signs of extension beyond the immediate area of involvement. Under nitrous oxide the lesion was excised with the cautery. The patient recovered without any complications.

CASE V.—March, 1911. Malignant pustule of right temple with œdema of the face. The patient was a white man, age sixty. The lesion had been present three days when he was admitted to the hospital. The pustule was small, about one-fourth of an inch in diameter and had a typical black centre without much induration at its border. The œdema was a little brawny and involved the scalp, the forehead, the eye-lids and the cheek. The glands of the neck were not tender, nor were they enlarged, and there was no evident lymphangitis. The bacillus was present in smears. The patient was kept in bed. The surface of the pustule was disinfected with pure carbolic and alcohol several times a day. The slough separated, the œdema gradually subsided, until on the sixteenth day there remained only the indolent ulcer which marked the location of the pustule.

CASE VI.—May, 1920. Malignant pustule on the nose, general infection. The patient was a white man, age thirty-five. The primary lesion was a small pustule on the nose which had been present forty-eight hours. The black slough was partly separated. The entire face and both sides of the neck were greatly swollen and brawny. The œdema involved the scalp, closed the eye-lids and filled out the recession of the neck under the angle of the jaw. The lymph glands were swollen and tender. The temperature was 104. There was marked dyspnoea and the skin was purplish red in color. Blood cultures proved negative, but anthrax bacilli were recovered from the pustule by smear and by culture. A dose of thirty cubic centimetres of anti-anthrax serum was given intravenously. The pustule was kept covered with small sponges of gauze, wet with mercurachrome solution. In the next twenty-four hours considerable improvement took place in the general condition of the patient, but he still had fever of 102 and the œdema was very slightly diminished. Another 30 c.c. of serum was injected intravenously. The temperature fell to 99.8 in the next eight hours and gradually falling remained normal after the fourth day. The bacilli were found in smears from the pustule for five days, after which time they disappeared. The swelling of the neck subsided rapidly after the fourth day. The pustule gradually dried up and on the tenth day was represented by a small scaly area on the nose. The patient was discharged cured on the fourteenth day.

## TREATMENT OF DIVERTICULUM OF THE ŒSOPHAGUS\*

BY CHARLES H. MAYO, M.D.

OF ROCHESTER, MINN.

DIVERTICULUM of the œsophagus has long been known and described. The rarity, lack of examining facilities, especially before the utilization of the Röntgen-ray, have delayed a thorough understanding of the condition. Bell, in 1830, recommended and made an external fistula into the sac. Rokitansky, in 1840, described and made two classifications of diverticula of the œsophagus; first the pulsion or pressure sacs forced out from within, and second, those caused by traction. Kluge, in 1850, recommended extirpation. Zenker and Ziemssen, in 1877, described the condition often called the Zenker pharyngo-œsophageal diverticulum. It is probable that Nichaus, in 1881, made the first extirpation.

Diverticulum of the œsophagus, a disease of adult life, is more common than generally realized. If it were regarded as not uncommon, those causing symptoms might be discovered early when the sac is small or at least before it becomes intrathoracic. Almost all such patients observed in the Clinic have received treatment for throat trouble or difficulty in swallowing for a considerable period, and a large percentage of cases were unsuspected as such. In some instances the condition was believed to be due to stricture, benign or malignant. The pulsion diverticula are pushed out from within by violent peristaltic action at this the narrowest part of the canal behind the cricoid. The traction type of diverticula are small, and are situated at about the level of the bifurcation of the trachea; they are usually caused by the suppuration of infected glands. They are rare, being found most often at necropsy, and seldom cause similar symptoms. They probably occur under tension; some may be congenital but not progressive. Judd reports a case seen in the Clinic of congenital stricture of the œsophagus causing a diverticulum-shaped pouch in the upper œsophagus in a child of twenty months who was cured by one dilatation.

All of the pulsion type of diverticula eventually become surgical with increasing severity of symptoms. They occur directly back of the cricoid cartilage on the posterior wall of the œsophagus at the juncture of pharynx and œsophagus. The weakness of the muscle and the covering at this point was noted by Lannier and by Hackerman, and is called the Lannier-Hackerman area. This is where evolution in changing the cephalic stomach and straight gut of invertebrate life to the anterior or vertebrate position, united the mouth with the œsophagus. A more common point for diverticulum to occur from congenital defect is where the intestine, in development, is inclosed within the abdomen at the umbilicus, known as Meckel's diverticulum. Once the œsophageal muscle is penetrated the sac gradually enlarges and develops a semi-

---

\* Read before the Southern Surgical Association, Memphis, Tenn., December, 1922.

inflammatory or traumatic thickening of the fibrous tissue, at first in the middle line growing down in front of the spine, then bulging to the sides, and increasing usually somewhat more to the left. The large sacs grow into the mediastinum becoming intrathoracic; once there they increase more rapidly in size. Such sacs holding approximately a pint of material each have been seen in the Clinic. The wall of the sac, when large, is much thinner, the layer of mucous and fibrous tissue being about 0.15 centimetre thick and more fused. The small sacs are somewhat thicker in the fibrous layers, less in the mucous, and are more easily separated.

*Symptoms.*—The inception is probably rarely recognized as it is only possible when there is trouble in swallowing. Later irritation of the trachea and pressure on the recurrent nerves may lead to a troublesome cough. A varying degree of dyspnoea may occur with pressure, both conditions indicate a probable intrathoracic sac. The difficulty in swallowing (dysphagia) is much like that of stricture or malignancy.

*Diagnosis.*—The larger sacs become direct continuations of the upper œsophagus. It is difficult for sounds or probes, even if small, to be passed down the œsophagus without slipping into the sac. Dr. H. S. Plummer early developed the use of the silk thread guide. One end of about five yards of thread is swallowed and the other pinned to the clothing; usually within a few hours, or a day, the thread passes through the stomach and far enough into the intestines to stand traction. This method was first used by Mixter of Boston, as a guide in dilating strictures of the œsophagus. By threading the silk through the end hole of a sound or olive-tip probe and drawing it taut, the instrument, which previously is stopped at the end of the sac, now passes directly to the stomach along the thread guide. Plummer's suggestion, in addition to its common use, is to hold the thread less taut and to pass the probe to the bottom of the sac, then the distance the rod is elevated by tightening the thread, until the probe passes into the opening in the anterior wall and down the œsophagus, gives the exact depth of the sac. The thread is swallowed afterwards and passes through the intestine. The œsophagoscope is of some value, when available, in the examination of these cases. Such modifications as swallowing a chain, inserting a shot-filled tube with fluoroscopic examination, the Strauss method of measuring the capacity of sac, and dilatation by their distention with air blown rubber balloons passed empty on stomach tubes, are no longer necessary. While small sacs give trouble enough, patients with large sacs are often greatly emaciated by long starvation. In such cases a small stomach tube or a large catheter is passed down the thread and daily feedings given to prepare the patient for operation. This method of building up the patient is most satisfactory and makes gastrostomy by tube, recommended by König, Payr and Bevan, rarely necessary. The sacs, by enlarging the neck, are often of sufficient size to be seen. On compression the fremitus of air and fluids is distinctly felt and often the contents can be partly regurgitated into the mouth. The visual test, by röntgenograms, is of the greatest

value. The barium emulsion is given in amount sufficient to more than fill the estimated capacity of the sac and a röntgenogram made which gives accurately, depth, location and size, with experience in reading the plates, rendering other methods unnecessary. Considerable dilatation above a high stricture may occur, but the narrow line of barium is seen passing down through the œsophagus stricture below the pouch.

*Treatment.*—Several methods have been devised for removing or obliterating the sac. It has been suggested to pass the forceps to the bottom of the sac, open them, grasp the inside of the sac, draw it up like the finger of a glove, and push it down the inside of the œsophagus. This method does not appeal to a surgeon, as even the small sacs for which only it might be considered, are fairly well fixed by adhesions. External surgical removal in one or two stages, change of position, or obliteration are methods of choice. If a general anæsthetic is used the sac must be well emptied before operation. About thirty years ago while I was bringing up a large intrathoracic sac, the patient who was under a general anæsthetic, almost suffocated by the contents pouring into the trachea; he very nearly died later from bronchopneumonia. This experience led to the employment of a local anæsthetic, usually novocain, with some preliminary morphin, in practically all such cases.

According to the literature only a few hundred patients with diverticulum of the œsophagus have been operated on. Although the condition is benign the mortality has been as high as for more serious operations, such as malignant conditions in the abdomen. In one series of 200 collected cases reported in the literature there were sixteen deaths; in another of 109 cases, twelve deaths, and in one of 100, ten deaths after one-stage operations, and twenty-eight fistulas. Some time ago Doctor Judd presented a record of fifty-two cases operated on at the clinic with three deaths. The number of cases has now been increased to seventy-four without further mortality.

To me the size of the sac (seldom mentioned, in literature) is an essential point. All surgeons recognize the danger of acute infective conditions of the mediastinum. When the sac is small the surgeon has a choice of procedure, but a two-stage operation with the sac unopened at the first operation is necessary in those cases in which the sac extends to the thorax. In a few cases the cause of death is given as bronchopneumonia. I believe the condition may result when a general anæsthetic is given and the contents are expressed above the tracheal opening for aspiration into the lungs. Certain surgeons, notably König, recognizing the dangers of infection, cellulitis and the troubles of fistula, elevate the sac, fixing its fundus to the hyoid bone. Wildenberg, in seven cases reversed or changed the direction of the sacs, later removing three of them. Liebl fixed the sac to the skin incision, leaving it unopened. Ligating the neck of the sac, leaving it to slough out of the packed wound has been recommended by von Beck, who reported two deaths from pneumonia in seven cases. Goldman, at an early period, showed by this method 65 per cent. of fistulæ with septic cellulitis and slow healing. Murphy delivered the unopened sac through the incision, twisted it, and later amputated and closed the fistula,

a method used in one case in the Clinic with success. Girard, in 1896, invaginated the sac by suture, in two cases. Von Beck invaginated the sac by suture, double suturing and reefing to obliterate it without opening. Bevan, at the suggestion of Sippy, performed this operation evidently on a large sac, as he used two or three purse-string sutures to invaginate the outer part of the sac, and reefing sutures for the lower half, leaving the sac compressed at its attachment. His report suggests that one patient died because the sac invaginated into the cesophagus and being forced upwards by vomiting, caused suffocation from blocking the trachea. He mentions the advisability of removing half of a large sac and treating the remainder.

Bensaude, Grégoire and Guénaux believe the one-stage operation best, and that the two-stage is an unnecessary precaution. I believe, with Hartman, that the danger of such procedure is too great in the case of large sacs for the little that is gained in time.

The operative incision usually recommended is parallel to the anterior border of the sternomastoid muscle. A better incision is one made in the line of the natural crease of the neck, one-third being behind the anterior border of the sternomastoid, and the skin and platysma muscle dissected both ways from this line; this affords a blunt dissection with hardly a vessel to ligate. With blunt retractors the sternomastoid and omohyoid muscles, the internal jugular vein and common carotid artery are drawn back; anteriorly the sac is seen just behind and extending below the cricoid cartilage. In one of my earlier cases I deemed it advisable to pass a ureteral sound through the mouth into the cesophagus and to push the sac into the incision, an unnecessary procedure, but one recommended by Deis. Bartlett suggests a method to identify the sac which I have not as yet had opportunity to test. With incision and dissection complete to the region of the diverticulum, the patient being under a local anæsthetic, is instructed to close the lips and distend the mouth and pharynx with air, and thus distend the sac. This is a simple procedure and well worth trying. The sac is lighter colored than the surrounding tissues and has a small plexus of veins over it. Carefully held by forceps, blunt dissection separates it from the tissues in contact, and this is facilitated by a piece of gauze held in artery forceps. Large sacs are drawn up from their intrathoracic position with but little added difficulty, care being taken not to open or injure by rough pinching with forceps.

In both small and large sacs there is little difficulty in amputating and suturing at the juncture with the cesophagus, using two rows of chromic catgut and a small soft rubber drain. The technical difficulties are not great. Gauze, often mentioned as a drain, should not be used in a suture case, on account of the added danger of fistula.

Large sacs should be delivered unopened, packed around with a layer of gauze, or placed within a soft rubber drain to prevent healing to the incision and skin, and should be amputated and closed by suture in from ten to twelve days.

## DIVERTICULUM OF THE ŒSOPHAGUS

In the period between the first and second stages of the operation, the mediastinal space becomes closed and protected by granulation tissue. I believe that the success and low mortality shown in the treatment of an unusually large number of these patients during the last thirty years justifies the safety of the method and this additional report concerning it.

### BIBLIOGRAPHY

- <sup>1</sup> Bartlett, W.: Personal Communication.
- <sup>2</sup> v. Beck: Quoted by König.
- <sup>3</sup> Bell: Quoted by Bensaude, Grégoire and Guénaux.
- <sup>4</sup> Bensaude, R., Grégoire, R., and Guénaux, G.: Diagnostic et traitement des diverticules œsophagiens. *Arch. d. mal. de l'app. digestif.*, 1922, vol. xii, pp. 145-203.
- <sup>5</sup> Bevan, A. D.: Diverticula of the Esophagus. *Jour. Am. Med. Assn.*, 1921, vol. lxxvi, pp. 285-288.
- <sup>6</sup> Dies, K.: Die Behandlung der Zenker'schen Pulsionsdivertikel der Speiseröhre. *Beitr. z. klin. Chir.*, 1921, vol. cxxiii, pp. 623-632.
- <sup>7</sup> Hartman: Quoted by Bensaude, Grégoire and Guénaux.
- <sup>8</sup> Girard, C.: Du traitement des diverticules de l'oesophage. *Assn. franc. de Chir.*, 1896, vol. x, pp. 392-407.
- <sup>9</sup> Goldman: Quoted by König.
- <sup>10</sup> Judd, E. S.: Œsophageal Diverticula. *Arch. Surg.*, 1920, vol. i, pp. 38-52.
- <sup>11</sup> Kluge: Quoted by Bensaude, Grégoire and Guénaux.
- <sup>12</sup> König, F.: Zur Operation des Oesophagusdivertikels. *Deutsch. med. Wchnschr.*, 1922, vol. i, pp. 719-720.
- <sup>13</sup> Liebl: Quoted by König.
- <sup>14</sup> Mixter, S. J.: Congenital Œsophageal Pouch, Excision, Immediate Suture of Œsophagus, Recovery. *Tr. Am. Surg. Assn.*, 1895, vol. xiii, pp. 357-360.
- <sup>15</sup> Murphy, J. B.: Diverticulum of the Oesophagus, Conservative Treatment. *Surg. Clin. Chicago*, 1916, vol. v, pp. 391-395.
- <sup>16</sup> Nichaus: Quoted by Bensaude, Grégoire and Guénaux.
- <sup>17</sup> Payr: Quoted by König.
- <sup>18</sup> Plummer, H. S.: The Value of a Silk Thread as a Guide in Œsophageal Technic. *Surg., Gynec. and Obst.*, 1910, vol. x, pp. 519-522.
- <sup>19</sup> Sippy, B. W.: Quoted by Bevan.
- <sup>20</sup> Wildenberg, L.: [Diverticulum in Esophagus.] *Arch. Franco-Belges d. Chir.*, 1922, vol. xxv, p. 526.
- <sup>21</sup> Zenker, F. A., and Ziemssen, H.: Krankheiten des Œsophagus. *Ziemssen's Handbuch der speciellen Pathologie und Therapie*. Leipzig, 1877, vol. vii, part 1.

## THE METASTASIZING TENDENCY OF ŒSOPHAGUS CARCINOMA

BY GORDON F. HELSLEY, M.D.  
OF FRESNO, CALIF.

CONSIDERABLE attention has been given in the last two decades to the question of the radical surgical treatment of œsophageal cancer, and successful resections have been reported in the recent past (Torek,<sup>1</sup> Zaaier,<sup>2</sup> Lilienthal,<sup>3</sup> Küttner,<sup>4</sup> Hedblom<sup>5</sup>). One of these cases has since succumbed to a recurrence of the growth (Lilienthal<sup>6</sup>).

It is our purpose to consider the tendency of this neoplasm to form metastases. If this occurs early in most cases it would seem futile to attempt to devise methods for the radical operation, a procedure which must always have an immediate mortality. One would hardly be justified in subjecting a patient to an operation which would be quite apt to cause his death, and which if successful would in all probability only substitute for an earlier death by starvation, perforation, etc., a somewhat delayed death by the growth of metastases.

But there has been for many years a fairly general belief, expressed by Förster and Billroth (quoted by Kraus<sup>7</sup>), that carcinoma of the œsophagus is not prone to metastasize early (Sauerbruch,<sup>8</sup> Guisez,<sup>9</sup> Meyer<sup>10</sup>).

On the other hand, Ewing<sup>11</sup> writes that these tumors form early and extensive metastases. McRae,<sup>12</sup> with a small series of autopsy cases, says that metastases are found comparatively seldom only because the patients die too early in the course of the disease or else the metastases are overlooked post-mortem. Kraus (*loc. cit.*) states that the opinion of Förster and Billroth is controverted by the contributions of Petri, Zenker and Colle, reporting metastases, in their respective series, of 59.5 per cent., 60 per cent., and 62.5 per cent.

Unanalyzed figures from post-mortem statistics have only a limited clinical application. We are less interested in the final condition than in the condition when the diagnosis can first be made. If it were only possible to know to what extent metastases were present when the respective patients began to suffer from dysphagia, we would have a much more valuable insight into the matter.

However, we may compare the figures quoted by Kraus to corresponding figures for carcinoma of the stomach, and we will then find that they really indicate that œsophageal cancer is not particularly prone to metastasize. Konjetsny<sup>13</sup> says that cases dying from carcinoma ventriculi are only in exceptional cases free of metastases, quoting Redlich with 84 per cent. metastases in 178 cases, and Feilchenfeld reporting 85.8 per cent. metastases.

In an extensive study Kitain<sup>14</sup> found 68.5 per cent. of œsophageal carcinoma showed metastases, but excluding the local metastases in the



adjacent lymph-nodes the figure is 46.4 per cent. In the same series cancer of the stomach showed 82.1 per cent. metastases, which figure was reduced to 71.4 per cent. by omitting the regional lymph-node metastases.

Similar findings are reported by Von Mielcki,<sup>15</sup> and we have been unable to find any series that did not show for the carcinoma of the oesophagus a definitely less pronounced tendency to metastasize than gastric carcinoma. The *possibility* of metastases from a cancer of the stomach is not a contra-indication to operation. Simply because the cancer has existed for a considerable time the medical attendant does not decide that the case is hopeless, assuming that metastases have probably occurred. Bearing in mind the comparative figures for oesophagus and stomach, one would hardly expect that the possibility of metastases in carcinoma oesophagi would be advanced as a contra-indication to operation. And yet that is what is being done in some of the best clinics of the world, the patients often being comparatively young men in good condition, free of any evidence of secondary growths.

In 75 cases of carcinoma oesophagi Sebening<sup>16</sup> found 72 per cent. were free from organic metastases. Hampeln<sup>17</sup> found in not a single one of his 60 autopsy cases organic metastases, except where the tumor had invaded the stomach or pharynx. Since our study was completed an article has appeared from the Eiselsberg Clinic in Vienna in respect to 132 cases of carcinoma oesophagi, in which 66 per cent. were free from any metastases (Starlinger<sup>18</sup>).

Our study concerns 70 fatal cases of carcinoma of the oesophagus at the Franz Josef Hospital in Vienna. They have been separated, according to the pathological picture, into the following classes:

I. Local; carcinomas that show no metastases.

II. Metastatic in regional lymph-nodes, this including secondary growths in the oesophagus itself, in the retro-oesophageal nodes and adjacent nodes of the posterior mediastinum, and nodes around the cardia.

III. Metastatic in more distant lymph-nodes or in other organs.

Group I included 45 cases, a percentage without any metastases of 64 per cent., agreeing remarkably closely with Starlinger (*loc. cit.*). Group II had 4 cases, or 6 per cent. This gives 70 per cent. of our cases free from distant or organic metastases, as compared with Sebening's (*loc. cit.*) figure of 72 per cent. The evidence seems plain that even up to the termination of life, oesophageal cancer shows a rather limited metastasizing tendency.

In 59 cases we were able to determine from the clinical histories the duration of the symptoms referable to oesophageal disease. In two cases the period was zero as there was never any manifestation of the cancer, and they came to autopsy undiagnosed. This is by no means a novel occurrence and emphasizes the fact that in all cases the beginning of the disease doubtless antedated the onset of symptoms by a considerable period. However, the average duration of symptoms was 5.2 months.

Of 39 cases without metastases the average duration of symptoms was 4.84 months. Two cases had symptoms one year or over and ten others

six months or over, and all were free of metastatic growths. We may directly conclude that in the majority of cases early in the course of the complaint, carcinoma of the œsophagus is a local disease.

Study of the metastasizing tendency according to the location of the tumor in the upper, middle, or lower portion of the œsophagus did not reveal any facts of significance. We had, however, only four cases of cancer of the upper segment.

As previously intimated, we are most of all anxious to know just how many of these cases have metastases early in the course of their complaint. As more cases are operated on, this problem can be more accurately worked out. In our series four patients underwent radical operative treatment for carcinoma of the thoracic œsophagus. In all four it was possible to resect the growth, but none lived more than a few days after operation. Operative record and autopsy showed that two of the cases with a duration of symptoms of eight and ten months, respectively, were free of metastases. Two others with duration of symptoms of one and five months, respectively, showed metastases in regional lymph-nodes. In one all the metastases were removed at operation; in the other a cancerous lymph-node was found post-mortem at the diaphragmatic hiatus.

In addition to these four cases there were a number of other patients whose lives terminated not as result of the carcinoma *ex ipso*, but because of failure to recover from operation, namely, gastrostomy. These can by no means be regarded as early cases. Often the operation was done on patients who without it would have lived but a few days. The very fact that they were unable to survive such an operation is an index to their condition. However, we may believe that on the average they represent a somewhat earlier stage than the main body of the cases and definitely earlier than the group who survived gastrostomy and lived for some time nourished through the stomach fistula.

In our series there were 42 gastrostomies done. Of these, 28 lived *less* than 20 days after operation, an average of five and three-fourths days, while 14 lived *more* than 20 days after operation, an average of seventy-four and three-fourths days. The 28 cases fall into the pathological groups as follows:

I, 75 per cent.; II, 7 per cent.; III, 18 per cent.; compared to the 14 cases that survived gastrostomy for a considerable period: I, 57 per cent.; II, 0 per cent.; III, 43 per cent. Admitting that our series is small, yet we believe that these figures, which speak for themselves, are extremely significant. The second group outlived the first group by 69 days, by which period the percentage of cases showing general metastases is changed from 18 per cent. to 43 per cent. We can well realize wherein Willy Meyer spoke wisely when he said <sup>19</sup> that carcinoma of the œsophagus is to be treated as an emergency case and that there is no time to be lost in its accurate diagnosis and surgical treatment.

## METASTASES OF ŒSOPHAGUS CARCINOMA

### CONCLUSIONS

1. In 70 fatal cases of carcinoma of the œsophagus, metastases were present in 36 per cent. In 6 per cent. the secondary growths were limited to the regional lymph-nodes. This indicates a limited tendency to metastasize.

2. The average duration of symptoms, 4.8 months, in the patients who died without metastases indicates that in the majority of cases ample time is given for diagnosis and treatment before metastasis occurs.

3. However, the striking change for the worse in the pathological picture during the average of 69 days by which the group that survived gastrostomy outlived the group that succumbed thereto, gives warning of the speed with which metastases develop in a somewhat advanced stage of the disease.

4. Irrespective of the duration of the disease, the possibility of metastasis formation, without definite evidence of same, should not be considered as a contra-indication to radical operation.

This work was done with the helpful coöperation of Prof. Dr. Stoerk, Professor of Histo-pathology at the University in Vienna and Prosector of the Franz Josef Hospital, and Hof-rat Prof. Dr. G. Lotheissen, Professor of Surgery at the University in Vienna, to both of whom I herewith wish to express my thanks.

### REFERENCES

- <sup>1</sup> Torek: Journal of Am. Med. Assn., 1913, vol. lx.
- <sup>2</sup> Zaaier: Beitrage z. Klin. Chir., 1913, vol. lxxxiii.
- <sup>3</sup> Lilienthal: ANNALS OF SURGERY, 1921, vol. lxxiv.
- <sup>4</sup> Küttner: Zentralblatt f. Chirurgie, 1921, i.
- <sup>5</sup> Hedblom: Surgery, Gynecology, and Obstetrics, 1922, vol. xxxv.
- <sup>6</sup> Lilienthal: ANNALS OF SURGERY, 1922, vol. lxxvi.
- <sup>7</sup> Kraus: Spec. Pathologie u. Therapie, 1902, vol. xvi, p. 1.
- <sup>8</sup> Sauerbruch: Munchen. Med. Wochenschrift, 1906, vol. liii.
- <sup>9</sup> Guisez: Revue Internat. de Med. et de Chir., 1920, vol. xxxiii.
- <sup>10</sup> Meyer: Ochsner's Surg. Diag. and Treatment, 1921, vol. ii.
- <sup>11</sup> Ewing: Neoplastic Disease, 1922.
- <sup>12</sup> McRae: Osler-McRae, System of Medicine, 1909, vol. v.
- <sup>13</sup> Konjetsny: Deutsche Chirurgie, 1921, vol. xlvi, p. 1.
- <sup>14</sup> Kitain: Virchow's Archiv., 1922, vol. ccxxxviii.
- <sup>15</sup> Von Mielcki: Zeitschrift f. Krebs Forsch., 1913, vol. xiii.
- <sup>16</sup> Sebening: Inaugural Dissertation; Bonn.
- <sup>17</sup> Hampeln: St. Petersburg Med. Wochenschrift, 1903, vol. xx.
- <sup>18</sup> Starlinger: Archiv f. Klin. Chir., 1922, vol. cxx, No. 3.
- <sup>19</sup> Meyer: Transact. of Amer. Gastro-enterol. Assn., 1920.

## PAPILLOMA AND ADENOMA OF GALL-BLADDER\*

BY IRVIN ABELL, M.D.

OF LOUISVILLE, KY.

BENIGN neoplasms of the gall-bladder have been regarded as of rare occurrence, the vast majority of tumors which have been observed in this organ and reported being of malignant type. A search of the literature reveals a paucity of articles dealing with or descriptive of benign tumors of the gall-bladder. Sutherland<sup>1</sup> in 1898 reported an adenomyoma; Ringel<sup>2</sup> in 1899 a papilloma; Stanmore Bishop<sup>3</sup> in 1901 described an unusual, innocent growth the size of a child's head, most probably a papillo-adenoma; A. W. Mayo Robson<sup>4</sup> in 1905 an adenoma; Mayer<sup>5</sup> in 1911 reported the transformation of the gall-bladder into a papilliferous tumor; M. Dominici<sup>6</sup> in 1911 reported a diffuse papilloma involving the entire mucous membrane of the gall-bladder and give a resumé of the literature up to that date. In 1911 Sand and Mayer<sup>7</sup> collected eight cases of papilloma. Irwin and McCarty<sup>8</sup> in 1914 reported the finding of one or more papillomas in 85 of 2168 gall-bladders, and in 1915 C. H. Mayo<sup>9</sup> reported 107 cases of papillomatous disease in 2538 cholecystectomies. The recent text-books and monographs on disease of the biliary tract either do not mention the incidence of such tumors in the gall-bladder or else dismiss the subject with the statement that they are of rare occurrence, while the description of benign tumors of the gall-bladder occupies but small space in the works on pathologic anatomy.

Papillomas, especially of the villous type, occur on the mucosæ with comparative frequency, particularly in the gastro-intestinal tract and are usually found in the course of chronic irritation, either mechanical, chemical or infective. The gall-bladder being a common site for chronic infective disease shows not infrequently the presence of such tumors when routinely subjected to microscopical study.

The adenomas are usually regarded as the best example of Cohnheim's theory of tumor genesis and the foetal types are readily explained by this hypothesis. So far, adenoma of the foetal type has not been observed in the gall-bladder while the adult type has been described by several observers.

The fact that only in exceptionally rare instances have the tumors given rise to symptoms *per se*, the clinical aspect being that of chronic cholecystitis and the microscopical picture that of chronic cholecystitis plus the presence of unsuspected tumor, would seem to indicate rather conclusively that the neoplastic development was secondary to the irritation of a chronic infection.

Both tumors, papilloma and adenoma, occur with and without the presence of stones, and ordinarily there is no correlation between the presence of the tumor and clinical symptoms.

---

\* Read before the Southern Surgical Association, Memphis, Tenn., December, 1922.

In 288 cholecystectomies done between July 31, 1915, and October 1, 1922 and subjected to routine microscopical examination, eight presented benign tumors, five adenomas and three papillary adenomas. In the five adenomas the tumor was single and small, in two of the papillary adenomas a large portion of the mucosa showed multiple papillary outgrowths while in the remaining papillary adenoma the mass filled the gall-bladder. In seven of the cases gall-stones were present, there being none in the case presenting the largest tumor growth. In seven in which the gall-bladder wall was sectioned and examined, chronic cholecystitis was present. The youngest patient was 31, the oldest 63, average age 48.3 years. All the patients were females; this doubtless is to be explained by the greater frequency of gall-bladder disease among women than among men. Seven of the eight, including the case in which no stone was present, gave a history of colics and all had suffered for years, from four to twenty, with digestive disturbance.

The clinical picture presented in all of the cases was that of cholecystitis and cholelithiasis and the findings at operation revealed that the symptoms in seven were correctly ascribed to cholecystitis with calculi while in the eighth the tumor was largely responsible for the appearance of symptoms. The case is of sufficient interest and rarity to merit a detailed report:

*Case Report.*—Female, white, age fifty-eight, came under observation first in August, 1919. Her father had died at the age of seventy-four with cancer of pancreas: family history otherwise negative. Her only severe illness up to the inception of the present had been typhoid fever at thirty-eight. She was married, had had no children and had passed the menopause at forty-seven. Her present trouble began in 1915, with an attack of pain under the right costal margin accompanied by chill and fever. She had similar attacks in 1916, 1917, 1918. During these years and for many preceding the onset of colic she had digestive disturbance, characterized by fullness after eating, gaseous distention and abdominal discomfort. Six weeks before coming to the infirmary she had a severe attack of colic requiring opiates for relief, followed by chill, fever and jaundice, the illness confining her to bed during this period of time.

Physical examination showed the skin and mucosa pale with a distinct icterus present. Temperature normal, pulse 84, cardiac dullness one-half inch outside nipple line with sounds distinct and regular: no murmurs present. Blood pressure 158-92. Lungs negative. Abdomen showed marked tenderness and rigidity under the right costal margin extending downward to umbilicus. Pelvis negative. Urine negative. Blood.—Hæmoglobin 80 per cent., red blood cells 4,080,000, white blood cells 12,200, polymorphonuclear neutrophils 68, small lymphocytes 25, large lymphocytes 6, eosinophiles .5. Diagnosis.—Acute cholecystitis. At operation, September 2, 1919, the gall-bladder was found covered by the stomach, intestinal and omental adhesions; upon separating these the wall and mesentery of the colon were found thickened and indurated, as was the liver tissue adjacent to the gall-bladder. The latter was thick-walled, rigid and apparently distended; upon introduction of trocar no fluid was obtained. Upon incising the gall-bladder it was found filled with a soft, friable epithelial mass, sessile in character and apparently involving the greater portion of its mucosa. A large amount of this was removed with the curette, bile appearing when the cystic duct was reached; no stones present. The whole picture appeared to me to be typical of a villous carcinoma, and the induration in the liver, wall and mesentery of colon was

interpreted as extension by contiguity and as rendering the case unsuitable for cholecystectomy. My conviction as to malignancy was so firm that none of the specimen was preserved for microscopical analysis. The gall-bladder was drained, the indurated area on colon and adjacent gall-bladder wall isolated by a cigarette pack and the abdomen closed. The patient was discharged from hospital nineteen days later and sent home with the diagnosis of advanced carcinoma of the gall-bladder.

I heard nothing further from her until in November, 1920, thirteen months later, when another patient from the same community, to my great surprise, told me that she had lost her jaundice, had gained in weight and strength and regarded herself as well. I saw the patient again July 8, 1922 and obtained the following history:

After returning home in September 1919 she continued weak and ill for four months, during most of which time she was in bed. The jaundice disappeared and the drainage wound healed. Beginning with January, 1920, she rapidly regained her health and strength and continued well until February, 1922, when she had an attack of colic followed by chill, fever and jaundice, being confined to bed for two weeks, all symptoms disappearing by the end of the fourth week. She then remained free of symptoms until May 28th, when she had another colic followed by chill, fever and jaundice and had been confined to bed until coming to the infirmary July 8th. Her weight was greater than at time of operation in 1919: pulse rate and temperature normal, heart and lungs negative. Distinct jaundice was present. Right upper rectus scar in good condition: slight tenderness on deep pressure under right costal arch, slight rigidity, no palpable mass. Blood showed—hæmoglobin 85, red blood cells 4,770,000, white blood cells 10,500, polymorphonuclear neutrophils 64.5, small lymphocytes 31.5, large lymphocytes 4. Urine showed a trace of albumin, much bile, occasional hyaline cast, four to ten blood cells and three to five leucocytes to the one-sixth field of the microscope.

Judging from her history subsequent to the operation in 1919 and her improved general physical condition it was evident that the conclusion as to the presence of malignancy was erroneous. It was now believed that the tumor observed in 1919 was a villous papilloma, but we were at a loss to explain the origin of the two subsequent attacks of colic; were they due to extension of the tumor, to adhesions or to common duct stone?

She was operated on July 12, 1922, with a diagnosis of common duct obstruction. The scar of former operation was removed and the abdomen opened, finding the stomach, duodenum and colon adhered to under surface of liver, and with the latter to the abdominal wall. Upon separating these, the gall-bladder was found to have disappeared, there being no visible vestige of it or the cystic duct. The common duct was enormously distended, no stones could be felt and the introduction of an aspirating needle into the duct failed to show the presence of fluid. The common duct was incised over the point of greatest enlargement and a mass of what appeared to be epithelial overgrowth, pale gray and cheesy in appearance, presented in the incision: the incision was extended and a large amount of this material removed, finding it to fill the common duct from the junction of the hepatics to the papilla of Vater. The growth sprang from the ductal mucosa at a point corresponding to the usual site of junction with the cystic duct, involving an area approximately  $1\frac{1}{2}$  inches long and  $\frac{3}{4}$  inch wide. The attached portion of the growth was removed with the curette and scissors and the base cauterized with the actual cautery. The distention of

the common duct was such that the finger could be easily introduced into each hepatic duct and the tip of the finger readily entered the duodenum at the papilla of Vater. The duct was drained with a T-tube, the incision in same sutured with catgut and the abdomen closed, bringing drain out a stab wound to right of abdominal incision. The jaundice disappeared, recovery was uneventful and the patient was discharged from the hospital well on the twenty-third day. Microscopical diagnosis of tumor was papillary adenoma, non-malignant.

The case presents certain interesting points: the size of the growth in the gall-bladder, its rarity and the close resemblance of its gross appearance to that of villous carcinoma, a frequent type of malignancy in this situation, is a prominent one. The presence of digestive disturbance years before the appearance of the first colic would argue for the existence of a chronic cholecystitis antecedent to the development of tumor; certainly the presence of inflammatory infiltration at the time of the first operation complicated the picture and contributed to the difficulty of correctly interpreting it.

Another point of interest is the complete disappearance of the gall-bladder and cystic duct although at the first operation nothing further was done than a curettement of the villous mass. Again, the size of the growth in the common duct, the enormous distention of the latter, with the typical clinical syndrome of common duct obstruction, most commonly due to stone.

Finally, was the growth present in the common duct at the first operation, or did it extend along the mucosa by contiguity coincident with the obliteration of the gall-bladder and cystic duct, or did it result from contact implantation as is so often noted in papillomata of the urinary bladder?

*Conclusions.*—1. Benign tumors of the gall-bladder, notably papilloma and adenoma, are not so rare as formerly thought, occurring in the Mayo series once in every 23½ cases of cholecystectomy and once in every 36 cases of the series herewith reported.

2. The invariable presence of chronic inflammatory changes in gall-bladders containing such tumors would argue the importance of chronic irritation as an etiological factor in their development.

3. The overshadowing clinical picture is that of cholecystitis, there being no correlation of symptoms with the presence of such tumors.

4. The fact that such tumors occur in the course of chronic cholecystitis is an additional argument in favor of cholecystectomy.

#### BIBLIOGRAPHY

- <sup>1</sup> Dr. Sutherland: Small Adenoma of the Gall-bladder. Glasgow M. J. n. s., vol. 1, p. 216, 1898.
- <sup>2</sup> Ringel: Papilloma of the Gall-bladder. Arch. f. klin. Chir., vol. lix, p. 161, 1899.
- <sup>3</sup> Bishop, E. Stanmore: An Undescribed Innocent Growth of the Gall-bladder. Lancet, vol. ii, p. 22, 1901.
- <sup>4</sup> Mayo Robson, A. W.: Adenoma of the Gall-bladder, vol. lxxxviii, p. 231, 1905.
- <sup>5</sup> Mayer: Transformation of the Gall-bladder into a Papilliferous Tumor. Jour. med. de Brux. vol. xvi, p. 85, (suppl.) 1911.
- <sup>6</sup> Dominici, M.: On a Rare Tumor of the Gall-bladder. Arch. f. klin. Chir., vol. xcvi, p. 487, 1911.

*Literature Reviewed by Dominici.*

- a. Aschoff: Verh der deutschen pathologischer gesellschaft, 1905.
  - b. Lustig: Patologia General, vol. ii, Milano, 1902.
  - c. Kaufmann: Trattato d'anatomia patologica. P. I. Vallardi-Milano. (Ger. ed. 1911, p. 633.)
  - d. Durante: Trattato di terapia e patologia chirurgica. V. 3. Roma, 1906.
  - e. Ribbert: Trattato di patologia generale. Vallardi, Milano. (Ger. ed., 1920, p. 533.)
  - f. Tillmanns: Trattato di patologia generale e speciale chirurgica. V. 3. Milano-Vallardi.
  - g. Bergmann: Trattato di chirurgia. V. 3. Milano, 1903.
  - h. Duplay: Trattato di chirurgia. V. 7, p. 1. p 315, Torino, 1895.
  - i. Terrier-Auvray: Chirurgie du foie et des voies billaires. V. 1, Alcan. Paris.
  - j. Hausson: Ein fall von papillon der gallenblase. Nordiskt mediciniskt Ark. 1905. V. 38. Abth. f. Chir. H. 2. No. 4.
  - k. Pels-Leusen: Ueber papillare Wucherungen in der gallenblase und ihre beziehungen zur cholelithiasis und zum carcinom. Langenbeck's Arch., 1906, V. 80.
- <sup>1</sup> Sand et Mayer: Arch de med. expir. et d'anat. path. Paris. 1911, vol. xxiii, p. 523.
- <sup>2</sup> Irwin and McCarty: Papilloma of the Gall-bladder. Collected papers of the Mayo Clinic, 1914, p. 179.
- <sup>3</sup> Mayo, C. H.: Papilloma of the Gall-bladder. Collected Papers of the Mayo Clinic, 1915, p. 249.



## WHITE BILE IN THE COMMON DUCT\*

By E. STARR JUDD, M.D.

AND

JOHN H. LYONS, M.D.

FELLOW IN SURGERY, THE MAYO FOUNDATION  
OF ROCHESTER, MINN.

THE term "white bile" is a misnomer; it is applied to the colorless liquid occasionally found in the obstructed common and hepatic ducts. Although the gall-bladder often contains a colorless liquid, such a liquid is only rarely found in the common and hepatic ducts. The origin and nature of this so-called white bile have long puzzled surgeons, but it has been quite generally believed that its presence indicates greater operative risk.

Kausch, in 1911, reported in detail a case of "white bile" in which he had operated, and reported thirteen other cases which he had collected from the literature. In none of these fourteen was the obstruction due to stone, and Kausch believed it unlikely that obstruction by stone would result in white bile. From a study of these cases he concluded that white bile is a secretion of the mucosa of the biliary passages which occurs with obstruction when the secretion of the mucosa of these passages is greater than its resorption. The biliary passages then become distended and the pressure in them gradually rises. When a certain point is reached, the direction of the flow in the liver is reversed, that is, the bile formed by the liver cells and the bile in the passages pass into the lymphatics and blood-vessels. As a result of this and the continued secretion of a colorless fluid by the mucosa of the biliary passages, the liquid in these passages becomes lighter and lighter, and finally colorless. Kausch recommended cholecystenterostomy for the condition.

In 1921, Rous and McMaster succeeded in producing white bile experimentally. They proved that it is the secretion of the mucosa of the biliary passages and occurs in obstructed ducts which are not connected with a functioning gall-bladder, that is, a gall-bladder which is concentrating its contents by absorption. In the dog and cat, the common duct is formed from three or more main hepatic branches, high in one of which the gall-bladder empties. In several cats and dogs and in one monkey, obstruction of the common duct, or of one or more of its hepatic tributaries, was produced in such a way that the gall-bladder still communicated with the channels in stasis. The stasis bile found later was heavily pigmented and syrupy, ropy, or tarry, according to whether the period of obstruction had been long or short. In several dogs, cats and monkeys, the common duct and the neck of the gall-bladder were obstructed, or one or more large hepatic ducts were tied and cut separately. The stasis fluid in these cases was at first brown, then green, but definitely less pigmented, and finally after ten or more days of stasis, became clear, and often completely colorless. In several dogs, a

---

\* Read before the Southern Surgical Association, Memphis, Tenn., December, 1922.

portion of the common duct was isolated by ligating and cutting it above and below. At various periods up to twelve days the animals were chloroformed and examined. The isolated segment was found uninflamed, but greatly distended in every case, and contained colorless, watery or mucinous fluid, identical with that mentioned. All of the animals had become jaundiced but none of the duct fluid was bile-stained. Cultures of this fluid were negative.

Berg, in 1922, in his monograph on the biliary system, expressed the opinion that white bile must be due to some cause other than obstruction, as, in a large number of cases, a similar obstruction produces dark, concentrated bile.

In the last four years 649 operations have been performed on the common or hepatic ducts at the Mayo Clinic. In this group were nineteen in which white bile was present; in nine of these, the obstruction was due to stone in the common or hepatic duct and in six to trauma at a previous cholecystectomy; in two the obstruction was due to carcinoma (one of the pancreas and one of the ampulla), and in one it was due to pancreatitis. In one case the white bile seemed to occur as a result of cholangitis.

The nine cases of white bile due to obstruction by stone in the common duct occurred among 361 cases of stone in the common duct, an incidence of 2.4 per cent. The six cases due to stricture occurred among thirty-three cases of complete stricture, an incidence of 18 per cent. The two cases in which the obstruction was due to carcinoma occurred among 108 cases of carcinoma of the pancreas and ampulla, in 1.8 per cent. The incidence in pancreatitis was not determined, as in most such cases there is no obstruction of the common duct.

Seventeen of our patients were intensely jaundiced at the time of the operation and there had been no recent decrease in the jaundice. One patient who was not jaundiced had a biliary fistula, but at operation retained colorless bile was found. The second case without jaundice presented interesting features. The patient had been having attacks of gall-stone colic for six months, but had not been jaundiced until the last attack which was three weeks before operation. He had only a moderate degree of jaundice and it had lasted only a few days. At the time of operation there was no trace of jaundice and no bile in the urine. At operation the gall-bladder was found to be greatly distended and there was a stone in the common duct beneath the pancreas, completely blocking the duct, which contained only clear watery fluid. Curiously the patient was not jaundiced as a result of the complete obstruction to the duct. The stone was removed and the opening in the common duct closed. The gall-bladder was removed and a tube stitched to the stump of the cystic duct. On the fourth day drainage of bile started. The patient left the hospital in good condition on the twenty-third day after operation but died nine days later. At necropsy acute hemorrhagic pancreatitis was found. The absence of jaundice with complete obstruction must have been due to the fact that the liver was no longer secreting bile, probably a very unusual occurrence.

It is not definitely known how quickly the contents of the common and hepatic ducts can become colorless. In our series of cases, the shortest period of continuous jaundice before operation was two weeks; the longest period was one year, the average duration sixteen weeks.

As we have mentioned, Rous and McMaster proved experimentally that white bile occurs only when the obstructed ducts are not connected with a normally functioning gall-bladder. Seven of our patients had had cholecystectomy elsewhere. Six of the remaining twelve were found to have marked cholecystitis at operation; two had acute empyema of the gall-bladder; one had a completely cicatrized gall-bladder; and three had greatly distended gall-bladders, in one of which were multiple stones. None of our patients had normal gall-bladders; in other words, they bear out the conclusions which Rous and McMaster made from their experimental work.

One case was very unusual. The gall-bladder contained green watery material while the common duct contained fluid which showed no trace of bile. The patient had been having gall-stone colic at intervals for a year, but had been jaundiced only two weeks. At operation marked cholecystitis was found. The common duct was twice normal size. The glands along the ducts were greatly enlarged. The explanation is that the gall-bladder was cut off from the common duct by the inflammatory process and the contents of the biliary passages became colorless before hydrops of the gall-bladder could be produced. A cholecystostomy and choledochostomy were performed. One hundred twenty cubic centimetres of bile drained the first twenty-four hours, 330 c.c. the next twenty-four hours, and 180 c.c. the next twenty-four hours. Bile appears in the ducts after drainage is established in a remarkably short time. In our cases in which drainage was established to the outside, bile appeared in the first twenty-four hours in all except one. This is the patient who had complete obstruction without jaundice. The bile did not drain until the fourth day. The common duct of one patient contained only colorless fluid; cholecystectomy and choledochotomy were performed and at the close of the operation, the drainage was bile-stained.

Hepaticoduodenostomy was performed in one case, choledochostomy in eight cases, cholecystostomy in three, cholecystostomy and choledochostomy in four, choledochostomy and cholecystectomy in two, and cholecystectomy with a tube sutured into the stump of the cystic duct in one case. In the nineteen cases there were four operative deaths, an average mortality of 21 per cent. One patient died of acute hemorrhagic pancreatitis after leaving the hospital, which is not considered here as an operative death. One of the patients who died had had cholecystostomy; the remaining three had had choledochostomies. Post-mortem examinations were obtained in three of these cases. In two, about 500 c.c. of blood was found in the peritoneal cavity; this was not sufficient to explain death, as both patients had been transfused after the operation. The bleeding was an oozing from all surfaces and not from any one blood-vessel. One of the deaths was probably due to shock caused by the sudden release of pressure in a completely

obstructed bile duct; the other two were probably due to insufficiency of the liver. The fourth patient probably died of insufficiency of the liver and uræmia. Necropsy was not obtained, but the blood urea the day before death was 176 mg. for each 100 c.c. While the operative mortality was high in this group of cases, it is probably no higher than it would be in a series of cases of complete biliary obstruction of the same duration with green bile in the common and hepatic ducts.

Loss of weight was a striking feature in the history of these patients. Often it suggested malignancy. One patient whose obstruction was due to stone, had lost thirty-two pounds in ten days, and a patient with a stricture had lost sixty-one pounds in one year. The average loss of weight was twenty-eight pounds. The average duration of the jaundice was sixteen weeks.

It cannot always be assumed that white bile indicates that the liver is not secreting. In fact, in our series, there was only one case in which the liver probably was not secreting bile. There are two reasons for believing that the liver does not necessarily cease to secrete bile; first, the elimination of bile in the urine would result in a decrease in the jaundice. Two of our cases were not jaundiced; the others had a good deal of bile in the urine, yet there had been no decrease in the intensity of the jaundice. Second, if the liver had ceased to secrete bile, it would hardly resume that function so rapidly after the establishment of drainage. As we have noted in one of our cases, the drainage from the tube in the common duct become bile-stained by the end of the operation.

It is a well-known clinical fact, that, if bile does not appear soon after establishing drainage of the common duct in a deeply jaundiced patient, the outlook is not good. Two of our patients who did not recover had slight drainage of bile for the first few days and then it stopped. One of the patients who recovered did not drain bile until the fourth day; it is possible that some of the bile was passing around the tube into the intestine, and yet no bile was found in the duct at operation. In view of what is known of a temporary cessation of function of other viscera, it seems possible that all hepatic function might be suspended for a time and still be entirely reestablished later.

It is improbable that we shall ever be able to operate in this type of case without mortality. The patient who died of uræmia might have been saved by the better pre-operative treatment now in use. In our experience most of the deeply jaundiced patients have uræmic tendencies, as is shown by the high percentage of blood urea. This can often be corrected by increasing elimination.

We have seen what we have termed "liver shock" in certain cases of jaundice. It has seemed to come after sudden, complete and permanent release of pressure in the common duct. The fluid in the duct had been under great pressure and, as soon as the duct was opened, a great amount of fluid escaped immediately, filling the entire operative field. This reaction has occurred in cases in which the fluid in the duct was bile, and also in those

in which it was white. The shock has usually come several hours after the operation when the immediate effects of the operation had apparently passed. Whether this reaction may be due to congestion in the hepatic tissue, caused by the sudden entrance of a large amount of blood into the vessels as a result of the sudden release of pressure in the hepatic ducts, we do not know. In cases in which the bile was under great pressure, we have tried to release it gradually by suturing a tube into the duct, without allowing all of the fluid to escape, and clamping the tube as a control. The clamp is released for a few minutes at intervals for the first few days, in this manner gradually decompressing the liver. Just how much this will accomplish in these cases is uncertain. We have employed it a number of times and in each case there was complete freedom from post-operative reaction. The post-operative bleeding, so often seen formerly in these cases, seems well under control by proper preliminary methods.

Cases in which there is white or colorless fluid in the common duct represent a very serious surgical type. They are not, however, necessarily fatal, as the finding of this fluid in the duct does not mean that the liver is interfered with more than in any deeply jaundiced patient. The colorless fluid or so-called white bile is a product of the glands of the duct wall. It is secreted under sufficient pressure to continue to form, regardless of the secretion of bile from the liver, and it collects in the ducts only when the activities of the gall-bladder are destroyed.

#### REPORT OF CASES

CASE I (A260954).—Mr. G. M., aged fifty-one years, was examined February 20, 1919. Since August, 1918, the patient had had four or five attacks of severe pain in the right costal arch, referred to the back, and accompanied by nausea and vomiting, and residual soreness in the region of the gall-bladder. Moderate jaundice had accompanied the last attack two weeks before. He had lost six pounds in weight.

Examination did not reveal evidence of jaundice. The urine contained albumin 1, but was otherwise negative. February 27, 1919, choledochotomy, cholecystectomy and appendectomy were performed. A rounded stone, 2 cm. in diameter, was found in the common duct under the pancreas; it crumbled during removal. The gall-bladder, and common and hepatic ducts did not contain bile, but were filled with clear fluid. Pancreatitis 2 was noted. There were no stones in the gall-bladder, which was greatly distended. Although obstruction apparently was complete, the patient had not been jaundiced. A tube was sutured into the stump of the cystic duct. Bile did not drain until the fourth day when 210 c.c. drained, and on the fifth, 180 c.c. The stools were colored after the operation. The patient left the hospital the twenty-third day, and died the thirty-second, from acute hemorrhagic pancreatitis.

*Comment.*—This case is particularly interesting, first, because, although the duct was apparently completely obstructed, the patient did not have the ordinary clinical signs of jaundice. In view of the fact that there was no bile-stained fluid in the gall-bladder or ducts, it would seem that the obstruction of the ducts had been complete. We are unable to explain this unless the liver had ceased secreting bile. It is further noteworthy that although the patient seemed to be in good condition after the operation, there was no sign of drainage of bile from the duct until the fourth day, when it gradually increased. The inflamed pancreas was noted at operation, but there was no evidence of

hemorrhage into it or of fat necrosis. We are unable to explain how the patient could live for several days without liver function, and also why the pancreatitis which apparently existed at the time of operation did not clear up with drainage of the common duct.

CASE II (A262802).—Mrs. P., aged twenty-nine years, had had a cholecystectomy performed elsewhere in October, 1918, because of soreness in the area of the gall-bladder, and dyspepsia. As long as the bile drained the patient felt comfortable, but in January, 1919, the opening closed, and she became yellow and jaundiced. She lost thirty-two pounds in weight.

The patient was jaundiced at the time of the examination, and bile 3 was found in the urine. March 14, 1919, choledochostomy was performed. The common duct was distended and completely occluded. The patient died on the day of the operation. Necropsy revealed 500 c.c. of blood in the abdomen.

*Comment.*—Because of the deep jaundice and complete obstruction the patient was recognized as an extreme risk. An attempt was made to establish the flow of bile through the duct with the hope of making a plastic reconstruction later. Immediately after the operation the patient seemed to be in good condition. Within a few hours, she showed signs of shock, such as has been observed on sudden release of pressure in a completely obstructed common bile duct. All possible efforts were made to correct this, without avail. A transfusion of 500 c.c. of blood was given. Necropsy revealed nothing of significance except about 500 c.c. of blood in the peritoneal cavity. We believe, however, that such bleeding often occurs after operations on jaundiced patients and that it is not sufficient to explain the cause of death.

CASE III (A294436).—Mrs. C. C., aged forty-three years, was examined October 24, 1919. She gave a history of having had gall-bladder disease since 1903. Cholecystectomy had been performed elsewhere in August, 1918. Two months later persistent jaundice had developed. The patient lost twenty-five pounds in weight in fourteen months.

Examination revealed jaundice and bile 2 in the urine. November 4, 1919, hepaticoduodenostomy was performed. There was complete obstruction of the hepatic duct at the site of the cystic duct. No bile, but 200 c.c. of clear fluid was found in the ducts. The pancreas was normal. On the sixth day post-operatively there was slight drainage of bile from the wound and none thereafter. The patient left the hospital on the seventeenth day.

*Comment.*—One point of interest in this case is that she had been continuously jaundiced for about one year, and was deeply jaundiced at the time of operation. At operation the liver was found to be greatly enlarged and there was complete obstruction of the common bile duct at the site of the cystic duct. The operation consisted of hepaticoduodenostomy, and while there was some drainage of bile to the outside on the sixth day, this stopped very shortly, and the wound healed in a short time. Apparently all of the bile that was being formed by the liver had been taken into the general circulation for a year, but as soon as the obstruction of the duct was relieved and the normal bile passage established, the jaundice subsided readily.

CASE IV (A307822).—Mrs. M., aged forty-four years, came to the Clinic, March 2, 1920, with a history of having gall-stone colic three years. She was first jaundiced six weeks before. The jaundice had been continuous for two weeks. She had lost thirty-three pounds in weight.

At examination, jaundice grade 2 was noted. March 13th, cholecystostomy and choledochostomy were performed. The common duct and gall-bladder were greatly distended and contained only mucoserous liquid. One stone was found in the common duct, and one in the gall-bladder. The condition of the pancreas appeared to be malignant. The patient left the hospital the eighteenth day, and

## WHITE BILE IN THE COMMON DUCT

was dismissed from observation March 10th, with bile still draining from the wound.

*Comment.*—The gall-bladder and ducts contained a clear, thick fluid. The day of the operation 45 c.c. of bile drained from the tube; the second day 300 c.c. drained and the third, 240 c.c. Apparently as soon as the clear fluid had escaped from the gall-bladder and ducts, the bile began to flow.

CASE V (A312770).—Mrs. F. K., aged forty-two years, was examined April 17, 1920. She had had gall-stone colic for two years. Jaundice had appeared after the last attack, two weeks before, and had persisted.

Jaundice grade 3, and bile 2 in the urine was found on examination. May 12th cholecystectomy and choledochostomy were performed. A large stone was found impacted in the ampulla of Vater. The common and hepatic ducts also contained a number of medium sized and small stones and thick mucus. At the close of the operation normal appearing bile was escaping from the drainage tube. The pathologist reported acute empyema of the gall-bladder with cholelithiasis and pancreatitis 2. Two hundred forty cubic centimetres, 300 c.c., and 300 c.c. of bile drained in the first three twenty-four hour periods respectively. No bile drained after the ninth day. The patient left the hospital the fourteenth day.

*Comment.*—This case is of special interest in view of the fact that although the patient was deeply jaundiced the condition had been present for only a few weeks. At operation a complete obstruction of the duct by a stone at the ampulla of Vater was found, and although the duct contained fluid which was not bile-stained it emptied, and the bile started draining as soon as the obstruction was removed.

CASE VI (A317871).—Mr. H. M. K., aged forty-nine years, was examined May 31, 1920. He had had gall-stone colic for six years. Jaundice accompanied the last attack which started nine days before. The jaundice persisted. The patient had lost thirty-two pounds in ten days.

Examination showed jaundice 3, and bile 3 was noted in the urine. June 7th partial cholecystectomy and choledochostomy were performed, and subacute cholecystitis with one stone blocking the cystic and common ducts was revealed. The walls of the gall-bladder were not very thick, the common and hepatic ducts were dilated, and the gall-bladder and common duct contained only a thin, watery secretion. Two hundred seventy cubic centimetres, 300 c.c. and 270 c.c. of bile respectively, drained in the first three consecutive twenty-four hour periods after operation. No bile drained after the fifteenth day. The patient left the hospital on the seventeenth day.

*Comment.*—This case is of special interest to us because the stone which obstructed the common bile duct also completely obstructed the cystic duct, and interfered with any functioning of the gall-bladder.

CASE VII (A317760).—Mrs. M. K., aged fifty-six years, was examined May 31, 1920. She had had stomach trouble since girlhood; and gall-stone colics with jaundice since May, 1919. Jaundice had been continuous for two weeks before examination. No loss of weight was noted.

At examination bile 1 was found in the urine, but no bile in the stools. June 10th choledochostomy and cholecystostomy were performed, revealing a single stone in the common duct, which was dilated. There was no bile in the ducts, but the gall-bladder was contracted. Two hundred ten cubic centimetres, 210 c.c., and 360 c.c. of bile drained in the first three consecutive twenty-four hour periods following operation. The patient left the hospital on the twenty-third day; at this time there was no drainage.

*Comment.*—Clinically, this case represented the ordinary case of common-duct stone, and so far as could be determined, there was no means of suspecting the presence of white bile. The clinical evidence of jaundice was not as com-

plete as in some of the other cases, although the obstruction of the duct was complete. The flow of bile was established almost as soon as the obstruction was relieved.

**CASE VIII (A347053).**—Mrs. G. W., aged fifty-six years, was examined January 21, 1921. She had had gall-stone colic for four years. Cholecystectomy had been performed elsewhere September 29, 1920, and drainage of bile had persisted. December 7, 1920, an exploratory operation was performed, but the results were unsatisfactory as the patient went into collapse on the table. Bile drainage persisted, and the patient had lost thirty-five pounds in weight.

At examination jaundice was not evident, and there was no bile in the urine. Pre-operative treatment was not given. January 31st choledochostomy was performed. There were multiple abscesses throughout the abdominal wall, the retained bile was colorless, and the hepatic duct contained stones. The drainage of bile increased with each successive twenty-four hour period. The patient left the hospital on the twentieth day. February 11, 1922, hepaticoduodenostomy was performed, but the patient died on the day of operation from hemorrhage.

*Comment.*—In this case the white bile was the result of stricture formation, which completely obstructed the duct.

**CASE IX (A339670).**—Mrs. M., aged fifty-five years, was examined November 2, 1920. For twenty-five years she had had attacks of severe pain in the upper abdomen accompanied by chills, and fever. Morphine was required for relief. Two years before, the patient became jaundiced, and this condition persisted in varying degree for eighteen months, then apparently disappeared for several weeks. Later it reappeared, accompanied by pain, and was still present at the time of examination. The patient had lost sixty-five pounds.

Examination revealed jaundice 3+, with tenderness in the region of the gall-bladder, and albumin 3 with a trace of bile in the urine. The patient was sent home because of her poor condition, and calcium lactate was prescribed. She returned four months later, still jaundiced, and pre-operative treatment was instituted. March 31, 1921, cholecystostomy and choledochostomy were performed, revealing cholecystitis with cholelithiasis, biliary cirrhosis 3, pancreatitis 2. Moderate ascites was present, the liver was very large and the spleen could not be palpated. About 500 c.c. of gluey white fluid (white bile) escaped from the gall-bladder and common duct. Drainage of 180 c.c. of bile was noted the first day after operation, and the dressings were stained with bile 2. The second day 750 c.c. of bile drained and the third day, 420 c.c. The patient left the hospital on the twenty-ninth day, still jaundiced, with blood-stained bile draining.

*Comment.*—This case is one in which the jaundice had persisted for a long time, and at the operation, the gall-bladder and ducts were found to be greatly distended with a large amount of white bile. This is the only case in which ascites was present to any extent, and one of the possibilities is that the portal circulation may have been interfered with by pressure from the greatly distended bile ducts, as suggested by Kausch.

**CASE X (A354710).**—Mrs. R. W., aged thirty-four years, was examined April 7, 1921. Cholecystitis had been present eight years. In August, 1920, a cholecystectomy was performed elsewhere. Jaundice appeared eight days after operation, and was progressive. Forty pounds in weight were lost.

At examination the patient was jaundiced and bile 2 was found in the urine. A transfusion was the only pre-operative treatment given. April 13th choledochostomy was performed. The common duct contained colorless bile; much scar tissue was noted. Forty-five cubic centimetres, 60 c.c., and 90 c.c. of bile drained in the first three successive twenty-four hour periods, respectively. The patient died on the fifth day after operation. Necropsy revealed intra-abdominal hemorrhage.



## WHITE BILE IN THE COMMON DUCT

Impaired liver function was probably the important factor in producing death.

*Comment.*—This case emphasizes the risk of operating on deeply jaundiced patients. The patient, except for the jaundice, was apparently in fair condition. Operative procedures were no more than was necessary to reestablish the biliary flow. As occurs in a great many of such patients who do not recover, only a very small amount of bile drained at any time, but the amount was sufficient to show that the ducts and tube were not obstructed. The intra-abdominal hemorrhage in this case amounted to 500 c.c. During the five days after operation, the patient was given three transfusions of 500 c.c. each, which would more than offset the free blood in the peritoneal cavity.

CASE XI (A357381).—Mrs. D. B. S., aged fifty-three years, was examined May 6, 1921. Pain had been present in the right upper quadrant for six months. The patient was first jaundiced twelve weeks before, and the condition persisted in varying intensity. The patient had lost thirty pounds in twelve weeks.

At examination jaundice 4 was noted and bile 3 was found in the urine. May 15th, cholecystostomy was performed, and an abscess in the gall-bladder, containing 30 c.c. of pus, was found and drained. There was marked biliary cirrhosis, and white bile escaped from the common duct. Stones were found in the common duct, and it was thought best to remove them at a second operation. The bile drained freely. The patient left the hospital on the twenty-ninth day. August 6, 1921, a second operation, choledochostomy, was performed, at which time stones were removed from the common duct. The patient was dismissed from the Clinic August 25, 1921.

*Comment.*—This case represents the value of the two-stage operation in cases in which the severity of the condition is recognized.

CASE XII (A363696).—Mrs. J. D., aged fifty years, was examined July 5, 1921. She had been troubled by gall-bladder disease and colic for one year. Stools had been white for the last six months, and the patient had been jaundiced for one week prior to examination. The only previous operation was a uterine suspension. Seventeen pounds in weight had been lost.

On examination the patient showed marked jaundice, 3. Bile 2 was found in the urine, and pre-operative treatment for jaundice was given. July 12th cholecystostomy and choledochostomy were performed. Portal cirrhosis, slight pancreatitis, and very marked cholecystitis were noted. The gall-bladder was flaccid. The glands along the ducts were markedly enlarged, some green watery material was found in the gall-bladder, but no bile-stained fluid in the common duct, which was twice its normal size. The operator diagnosed the condition as cholangitis with cholecystitis. The drainage of bile in the first successive twenty-four hour periods after operation was 120 c.c., 330 c.c., and 180 c.c. respectively. The patient left the hospital on the twenty-third day after operation. No bile had drained from the wound since the thirteenth day.

*Comment.*—The explanation of the fact that there was bile-stained fluid in the gall-bladder and colorless fluid in the common duct must be that the ducts and the gall-bladder were separated by obstruction. This is the only case in which we were unable to determine the exact cause or the obstruction of the bile duct. It may have been due to the pancreatitis or the enlargement of the lymphatics. Although there was no bile in the common duct at the time of operation it nevertheless appeared from the drainage tube very shortly afterward. The patient was clinically well and the wound healed normally in the ordinary length of time.

CASE XIII (A365515).—Mrs. M. C. B., aged sixty years, was examined July 21, 1921. Five months before, she had had a chill and fever with vomiting, followed by jaundice which persisted. She had lost seventeen pounds.

At examination jaundice 3 was present. July 30th choledochostomy was performed. The gall-bladder was contracted, and a stone and white bile were found in the common duct which was dilated and completely cicatrized. Biliary cirrhosis 3, enlargement of the liver 3, and pancreatitis 1 were noted. The dressings were bile-stained the first day. One hundred ninety-five cubic centimetres and 300 c.c. of bile drained in the second and third twenty-four hour periods following operation. The patient left the hospital on the fifteenth day. No bile drained from the wound after the thirteenth day.

*Comment.*—While this case is clinically one of painless jaundice, the cause of the obstruction of the common duct was a stone. The obstruction must have been complete in view of the fact that there was no bile in the duct at the time of operation. The gall-bladder was apparently completely destroyed by inflammation. The jaundice cleared up after drainage, so that it was evidently not the result of cirrhosis or pancreatitis.

CASE XIV (A371864).—Dr. H. B. A., a man, aged fifty-six years, was examined September 12, 1921. He had suffered from gall-bladder disease for two years, and had lost sixteen pounds. He was jaundiced for three days before coming to the Clinic. Examination showed jaundice with bile 3 in the urine. Pre-operative treatment was given. September 27th, cholecystostomy was performed. One stone was found in the gall-bladder, the walls of which were thick. The common duct was greatly dilated and contained clear fluid. Obstruction of the common duct at the head of the pancreas, pancreatitis 3, and moderate biliary cirrhosis were noted. Sixty cubic centimetres, 120 c.c. and 270 c.c. of bile, respectively, drained in twenty-four hour intervals following operation. The patient left the hospital on the ninth day. The last dressing was removed October 19th, at which time bile drained from the wound.

*Comment.*—This case represents one in which swelling in the pancreas as the result of inflammation may have been sufficient to produce complete obstruction in the common duct. The inflammation apparently originated in the gall-bladder, which contained one stone, and very probably extended from there to the pancreas. We believe that the pancreas seldom becomes involved in inflammation to the degree of producing complete obstruction of the common duct, but undoubtedly it occurred in this case.

CASE XV (A388643).—Mr. E. G., aged fifty-seven years, was examined November 18, 1921. He had had pain in the upper abdomen with fluctuating jaundice for six months.

At examination jaundice 2 was noted, and pre-operative treatment for jaundice was given. December 1st cholecystostomy was performed. White bile and stony fragments were found in the distended gall-bladder and common duct. Pancreatitis 4 and biliary cirrhosis 3 were also present. The drainage of bile in the first three consecutive twenty-four hour periods following operation was 980 c.c., 1600 c.c., and 1650 c.c. respectively. The patient died on the ninth day from insufficiency of the liver. Necropsy revealed carcinoma of the head of the pancreas.

*Comment.*—Complete obstruction of the duct with formation of white bile in this case was due to carcinoma of the head of the pancreas. Death was probably caused by liver insufficiency and malignancy in the pancreas.

CASE XVI (A242658).—Mr. G. E. W., aged fifty-one years, was examined March 28, 1922. He had had stomach trouble for fourteen years. Eight and one-half years before, he began to have attacks of sudden pain in the epigastrium with bloating, and residual soreness requiring morphine. Recent attacks of pain localized in the right costal marginal area and were accompanied by chills and fever. Jaundice occurred with the last attack and persisted in a varying degree. There was no history of loss of weight. Appendectomy had been performed eight years before.

## WHITE BILE IN THE COMMON DUCT

Pre-operative treatment was given. April 25th, choledochostomy was performed. The Mayo-Robson hepaticus drain was used. The gall-bladder was definitely inflamed, but contained no stones. The common duct was dilated, and when opened, watery, colorless bile, and considerable mucus gushed from it. A stone which was wedged at the ampulla was removed without difficulty. Biliary cirrhosis was present. Convalescence was uneventful. Two hundred seventy cubic centimetres of bile drained during the first twenty-four hours; 360 c.c. during the next twenty-four hours; and 450 c.c., during the next twenty-four hours. The tube came out on the seventh day. There was no drainage of bile after the eighth day.

*Comment.*—It was difficult to make a diagnosis in this case, in spite of the fact that there was eventually a complete obstruction of the common duct. In several instances when the chief complaint was gastric, we were unable to determine that the patient had enough trouble to warrant an operation for gall-bladder disease.

CASE XVII (A376062).—Mrs. F. W., aged forty-eight years, was examined April 20, 1922. She had had gall-stone colic for twenty years.

August 3, 1921, cholecystectomy and choledochotomy were performed. The common duct was found to be distended and filled with stones. October 16, 1921, the patient had a chill and fever followed by jaundice which continued though the degree fluctuated. Since February the patient had had two attacks of colic. Loss of weight has been continuous (61 pounds in one year). April 28, 1922, following pre-operative treatment choledochostomy was performed. Hepatic cirrhosis 3 was present. The liver was large, firm, hard and granular, and oozed when it was touched. Many adhesions were noted. The common duct was large and dilated, and the distal part was apparently gone. No communication with the bowel could be located. On opening the common duct, about 180 to 240 c.c. of colorless fluid, with no suggestion of bile pigment, but containing considerable pus, escaped. It was believed that there was a stone in the common duct, but operation revealed none. A tube was placed in the duct. The patient did not improve. Sixty cubic centimetres of bile was drained in the first twenty-four hours, 60 c.c. in the next twenty-four hours, 90 c.c. in the next twenty-four hours, after which the drainage ceased. The patient gradually declined, and died on the eighth day. The blood urea was 176 mg. on the seventh day; the urinary output was satisfactory throughout. Necropsy was refused.

*Comment.*—The marked loss of weight in this case is characteristic of complete obstruction of the common duct. The case is also of interest because from the time of operation, although the patient seemed to be getting on satisfactorily, there was no increase in bile drainage and death ensued, apparently from insufficiency of the liver and uremia.

CASE XVIII (A277704).—Mrs. H., aged twenty-seven years, was examined April 20, 1922. She had had an appendectomy five years before. She had complained of severe pain in the left upper abdomen, with belching, bloating, and vomiting, required morphin for relief, and followed by residual soreness. The first attack occurred during pregnancy; two more attacks occurred later. Slight jaundice accompanied each attack. October, 1921, cholecystectomy was performed elsewhere, but no stones were found. Bile drained for two weeks. In January, 1922, the patient began to be jaundiced, and the jaundice gradually increased in severity. In March, 1922, she had an attack of sudden, severe pain in the left upper quadrant, with rigidity of the left upper rectus, requiring morphin, and followed by soreness in the upper quadrant. The patient had lost thirteen pounds in three months.

May 10, 1922, choledochostomy was performed. Post-operative biliary cirrhosis was found. The liver was small. Adhesions to the hepatic duct were separated, and the hepatic duct opened. Watery fluid, without bile pigment, gushed from the duct. A small opening was made in the hepatic duct, a rubber catheter was inserted, and its end closed, thus producing a condition very similar to that existing before operation. The pressure was gradually released in an effort to stimulate the liver function. Four post-operative blood transfusions, 300 to 500 c.c. each, were given. Chills occurred for several months. September 27th, another operation was performed to reconstruct the common duct. A T-tube was inserted. Three hundred cubic centimetres, 380 c.c. and 380 c.c. of bile drained in three successive twenty-four hour periods following operation. The patient left the hospital on the thirteenth day and was dismissed from the Clinic, October 13th, carrying a T-tube.

*Comment.*—At the time of the reconstruction of the common duct the jaundice had almost completely subsided. This patient is now wearing a T-tube which will be removed in a few months.

CASE XIX (A396281).—Mr. N. C., aged sixty-seven years, was examined June 29, 1922. He had had no previous diseases, except influenza in 1889. Three years before, cholecystectomy was performed elsewhere. He came to the Clinic because of jaundice, pruritus, and loss of weight. In September, 1918, he had an attack of pain in the upper abdomen, requiring a hypodermic; this attack was followed by soreness for several days. Three months later he became jaundiced and began to lose weight. His stools were white and he had no appetite. No stones were present at the time of the cholecystectomy in May, 1919. The jaundice cleared up in one month, and he began to gain weight and to feel well. In September, 1921, he again developed jaundice and lost forty pounds in weight; the jaundice persisted. For one month prior to examination, he had continuous dull pain in the epigastrium.

At examination, the patient was markedly jaundiced and bile 3 was found in the urine, and the stools were gray. July 24, 1922, choledochostomy was performed. Carcinoma of the ampulla was revealed, and the common duct was extremely dilated. The large and small intestines were very tense. Mucous-tinged, clear, colorless bile was found in the common duct. There was a movable, free growth in the ampulla.

*Comment.*—The extreme dilation of the common duct resulted from an obstructing neoplasm at the ampulla. We were able to put a small catheter into the common duct without releasing the pressure, and gradually to produce decompression. The fluid from the duct was at first colorless, but in six hours it became bile-stained. This patient is comfortable at present with the tube in his common duct. As he is sixty-seven years of age, there is some question as to the advisability of submitting him to operation for resection of carcinoma of the ampulla.

#### BIBLIOGRAPHY

- <sup>1</sup> Berg, J.: Studien über die Function der Gallenwege unter normalen und gewissen abnormen Verhältnissen. *Acta Chir. Scand.*, 1922, suppl. ii, 185 pp.
- <sup>2</sup> Kausch, W.: Der Hydrops des gesamten Gallensystems bei chronischem Cholechusverschluss und seine Bedeutung für den Chirurgen. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1911, vol. xxiii, pp 138-168.
- <sup>3</sup> Rous, P., and McMaster, P. D.: Physiological Causes for the Varied Character of Stasis Bile. *Jour. Exper. Med.*, 1921, xxxiv, pp. 75-95.

## THE SURGICAL TREATMENT OF CHRONIC ULCERATIVE COLITIS \*

BY HARVEY B. STONE, M.D.

OF BALTIMORE, MD.

THE purpose of this paper is to call attention to a condition of serious character and by no means rare occurrence, and to a method of treatment that, while well known, seems not to have been utilized as widely as its merits warrant. Chronic ulcerative colitis is advisedly referred to as a condition rather than as a disease. Its etiology is not always clear and is not limited to a single agency. Any infection, amoebic, pyogenic, tuberculous, luetic, or from unidentified organisms, may properly come under the descriptive name of chronic ulcerative colitis, and such cases are so included in this discussion. Other terms used in the literature with practically the same meaning are chronic dysentery, and chronic suppurative colitis. It is of course desirable, if possible, to determine the type of infection. The use of the proctoscope, the microscope and bacteriologic study of bowel contents, the Wassermann reaction, general physical examination, and the history of the case are all utilized to discover the nature of the infection. By these means a certain number of cases may be clearly recognized as amoebic, luetic, or tuberculous. The therapeutic test of antiluetic treatment or emetin treatment may also be of value. But there remains a considerable group of patients who present ulceration of the large bowel, with colon and pyogenic organisms present, and no more specific causal agent to be recognized. Certain cases indeed which begin as specific inflammations, as for instance amoebic colitis, later acquire a secondary infection that so predominates as completely to obscure, if not actually to crowd out, the original infection. It is particularly this ill-defined but important group of cases, in which specific therapy is of little avail, that forms the principal object of consideration in this paper. However, any type of infection of the large bowel that is chronic and does not yield to the usual methods of treatment is equally subject to the descriptive remarks and the ideas of treatment herewith advanced.

Patients with chronic ulcerative colitis present a history of bowel trouble extending back for months and sometimes for a number of years. The onset may have been abrupt with acute dysentery or gradual and insidious. Often there are periods of improvement; sometimes of apparent cure, followed by recurrence and another cycle of improvement. The severe attacks are marked by numerous bowel movements, perhaps twenty or more a day, consisting largely of mucus, pus and blood. During these exacerbations there are loss of weight, abdominal pains, often severe, usually some fever, and marked weakness. Eating becomes very difficult to these patients, not only because of complete loss of appetite, but even more because the entrance of anything

---

\* Read before the Southern Surgical Society at Memphis, Tenn., December, 1922.

into the stomach starts immediate reflex peristalsis in the colon with sharp pain and urgent desire to defecate. This particular symptom, as it happens, the writer does not recall ever seeing mentioned, but it has been an outstanding and troublesome feature of nearly every severe attack of chronic ulcerative colitis seen by him. Should the severe manifestations of the condition continue long, the patient becomes gravely ill, and it is not impossible for a fatal result to ensue. Even though, because of treatment or a spontaneous recession in the infection, life itself is not lost, there is great loss of weight and strength, and a condition of marked invalidism usually persists for weeks and months.

In the intervals between these fulminating periods, improvement slowly takes place, but usually with residual symptoms that show a persisting lesion in the bowel. There is a tendency to looseness and frequency of bowel movements, usually traces of blood and mucus in the stool, and with the proctoscope it may be seen that a hyperæmia and granular appearance or even actual open ulcers are still present. Such patients, though better, are by no means well. Recurrence is very apt to take place. In fact, one of the striking clinical characteristics of chronic ulcerative colitis is its chronicity and recurrent nature.

Such is a fair picture of a condition that is fairly often met with and that means usually prolonged invalidism, involving perhaps years, and that holds a by no means remote threat of death. What is there to do for it?

The usual means of treatment are well known to all. For the specific types of infection, the specific remedies; emetin and quinine irrigations for amœbic colitis; antiluetic treatment for syphilitic ulceration; general hygienic care for the tuberculous. In addition, and particularly for the non-specific type of infections, various rectal irrigations, with solutions ranging from normal salt solution through the various antiseptics; bland and simple diet; rest in bed; opiates for tenesmus; bismuth by mouth; during acute exacerbations fluid by hypodermoclysis and morphia freely. There are still other measures that various men resort to. It is not necessary to be exhaustive. Some cases perhaps get well, many get better for a while, a few die. Those, the majority, that only get better, sooner or later get worse again. Then the treatment, or another like it, is repeated. This sequence may go on for years. Is there anything better to do, and if so, when should it be done?

In 1895, Keetley suggested making use of the appendix as a semi-permanent opening for irrigating the infected bowel from above. Weir, in 1902, is credited with first performing appendicostomy. Since then this method of treatment for infections of the colon has been followed in English and Continental clinics, as well as in this country, and a considerable literature has grown up on the subject. (Paulus,<sup>1</sup> Lockhart-Mummery.<sup>2</sup>) The results of appendicostomy, however, are not always satisfactory. It allows irrigation, but the colon is still irritated by the passage of fæces; and a wider opening of the cæcum—cæcostomy—to allow not only irrigation of the colon, but also to divert the fecal stream and put the colon at rest, was done by Boas in 1903 for chronic ulcerative colitis. This has also its advocates, Klose,<sup>3</sup> von Lipp-

man.<sup>4</sup> But a cæcostomy does not really divert entirely the contamination and irritation of the ulcerated bowel by fecal matter. To secure complete physiological rest of the colon, the logical method is to do a complete transverse ileostomy, as is well brought out by Payne,<sup>5</sup> who credits Dr. John Young Brown, of St. Louis, with priority in advocating this method.

What are the relative merits of these surgical methods? The writer has had some, though not extensive, experience with all of them. In general, after any of these operations, even in severely ill patients, there is immediate and rather dramatic improvement. It is not an isolated experience to note that a patient who has had fifteen to twenty painful, bloody stools daily will pass the two or three days after operation without any movement of the bowels whatever. This sudden cessation depends less on the type of operation than on the fact that following invasion of the abdomen there is a temporary paresis of peristalsis and remission of symptoms. It is in the subsequent course of events that differences may be noted between the several forms of operative treatment. Appendicostomy has the very considerable advantage that it avoids to a large extent the disagreeable features of an artificial anus. Soiling and odor are minimal or absent. *But it does not always cure the colitis*, and recurrences and constant irrigation are drawbacks of great moment to its success. The large bowel is not excluded and the treatment may fail of its primary purpose, the cure of the lesion. Cæcostomy is no more certain in exclusion of the bowel and has all the disadvantages of a fecal fistula in addition. Ileostomy is a more logical method, promises better results and in the experience of the writer, limited to a very few cases, has entirely succeeded. Such is also the experience of Payne. It has the serious drawback of an artificial anus, and women patients particularly are apt to refuse it. But the liquid normal contents of the small bowel soon change in character and much of the difficulty experienced in control of cleanliness in the early period after operation disappears. The stools become semi-solid, regular, and a certain control is developed. The writer has had three cases. Two are entirely well after two years and one year, respectively, and the third has only recently been operated on, and is still under treatment. Neither of the other methods of operating in a larger series of cases have done as well. It is the distinct impression that ileostomy is the method of choice.

In what cases should operation be employed? It is my feeling that any severe exacerbation of a chronic ulcerative colitis is in itself an indication for an operation that may save life. Further, any chronic case, even without alarming severity of symptoms, that has resisted the usual medical treatment for a number of months, should be operated on to terminate indefinite invalidism.

How long should surgical treatment be kept up, in other words, when can the artificial opening in the bowel be closed and the normal function of the large bowel be restored? The evidences of cure of the ulceration are as follows: A normal appearance of the mucosa on proctoscopic examination; the disappearance of all symptoms; the absence of pus or blood

microscopically in centrifuged salt solution that has been run through the colon from the artificial opening to the anus. When these findings are maintained two months after the stoppage of all irrigations, it is safe to close the stoma and reestablish the continuity of the alimentary tract.

It is incidentally of interest to note how well patients tolerate complete exclusion of the colon. Both the cases now cured began to gain weight and strength at once after ileostomy, even with the entire colon thrown completely out of function.

The detailed steps of operation in all of these procedures are well known. The only comment that the writer desires to make in this matter is in regard to the method of closing the ileum used in the last case done. The steps described by Halsted<sup>6</sup> in his article on sterile blind end-to-end suture of the large bowel were adapted to this purpose. The ileum is divided by the cautery between two purse-string sutures, and the two blind ends are abutted against each other and a circular end-to-end suture of the bowel done by interrupted mattress sutures of fine silk. This leaves the ileum closed by a double diaphragm. The loop of ileum just above the ileocecal valve is selected for this purpose and then the gut about two inches proximal to the closure is brought up and fastened in the wound, to be opened some hours later and have a tube placed in it. This establishes the ileostomy and the colon exclusion. The appendix is then brought up through a separate incision and used as an opening to irrigate the colon. Should the appendix not be available a cone of cæcum may be used. Later, when ready for closure, the plan is to introduce a knife downward from the ileostomy opening, perforate the double diaphragm of the Halsted closure, and then close the ileostomy.

*Summary.*—(1) Chronic ulcerative colitis is an obstinate, recurrent, and dangerous condition.

(2) When it resists medical treatment or becomes severe, operative attack is indicated.

(3) Ileostomy and separate appendicostomy for colon irrigations, with exclusion of the colon from function, offers best results.

#### CASE REPORTS

CASE I.—A. J. L., white, male, age thirty-nine, admitted July 10, 1920, to the Johns Hopkins Hospital. Past history unimportant. Present illness began three years before admission with gradual onset. Had pneumonia in November, 1917, perhaps influenzal. In January, 1918, bloody diarrhœa began, at first without much pain. Some mucus in stools. In April, 1918, amœbæ found in stools, said to be amœbæ coli. Was treated with emetin and seemed to be well for six months, but still had a little trouble, tenderness over descending colon and two or three soft stools daily. After six months, return of diarrhœa and amœbæ found again. Continued treatment by emetin and quinine injections through the rest of 1918 and 1919. In February, 1920, symptoms became worse in spite of treatment, and has had constant diarrhœa since, ten or twelve stools daily. Proctoscope showed numerous ulcers of appearance of secondary pyogenic infection. After three weeks' treatment on medical service, transferred to surgical. On August 6,



1920, a transverse ileostomy was done by Dr. W. A. Fisher, Jr. Following this the bowel was irrigated with quinine, ipecac, and neo-salvarsan in dilute solutions for a period of several weeks. There was prompt and marked improvement. Symptoms entirely disappeared. Gain in weight. Disappearance of blood and mucus from bowel washings. Proctoscope showed ulcers entirely healed. On October 19, 1920, two and a half months after the ileostomy, the fistula was closed and the alimentary tract reestablished by ileocæcostomy. Patient was discharged November 10, 1922, having gained forty-five pounds since ileostomy. Has been followed since and has remained entirely well, with a final and sustained gain in weight of sixty odd pounds. No further symptoms of bowel trouble since operation for a period now over two years.

CASE II.—D. K., white, male, age thirty-three. Past history: Appendectomy for acute appendicitis. Otherwise not important. Present illness began in autumn of 1916 while patient was serving with the National Guard troops on the Mexican border. Onset rather acute with diarrhœa, blood and mucus being passed in large quantities. Rapid loss of weight and strength. After treatment for some time in army hospitals with gradual improvement, was sent home to Baltimore on sick leave. Examination then showed typical appearance of amœbic ulceration in colon and amœbæ were found in stools. Under emetin and quinine irrigations patient improved considerably, but never was entirely well, and had periods of recurrence of more severe symptoms. These were so disturbing that in 1919 he underwent several weeks of careful and rigid medical treatment in a hospital. He was much benefited and for three or four months seemed well. However, recurrence then developed and for two more years he suffered more or less constantly varying degrees of illness. In 1921, his symptoms became severe, with twelve to fifteen bloody stools daily, marked loss of weight and great abdominal and rectal pain. He accepted the suggestion of ileostomy. Operation was done at the Union Memorial Hospital October 28, 1921, a loop of ileum about fifteen inches above the ileocæcal valve being brought into a right rectus incision, fixed there, and transversely divided the next day. The upper arm of this loop constituted a fecal fistula and the lower arm was used to irrigate the colon. Salt solution, dilute silver nitrate, ipecac, neo-salvarsan, and yeast solutions, were used in turn. The patient's symptoms began to improve abruptly after operation and he gained about twenty pounds even while the ileostomy was open and the colon out of function. On January 31, 1922, the patient had been free of blood, mucus or pus, even microscopically in colon washings for several weeks, and the ileostomy was resected and intestinal continuity established by lateral anastomosis. Since the ileostomy, now over a year, the patient has been free from any symptoms whatever, has gained permanently some thirty pounds, and has not lost any time from his occupation. Incidentally, he was able to do work for several weeks of the time between his ileostomy and the closure of it.

CASE III.—Mr. L. S., white, male, age thirty-two. Past history negative except for pneumonia, 1905. Present illness began June, 1921, with diarrhœa and severe abdominal cramps. Under medical treatment there were short intervals of improvement, but prompt recurrences, severe enough to prevent patient from working steadily. In January, 1922, sent into hospital and stayed one month on medical treatment, rest in bed, and irrigations. Left hospital much better. In May, recurrence of severe type. June 9, 1922, appendicostomy. Much better, and while irrigations continued had little trouble. Discontinued irrigations in August. Appendicostomy closed spontaneously in October, 1922. Recurrence of symptoms in severe form soon after. Loss of twelve pounds in eight days. Bloody stools, fifteen to twenty daily, and great deal of abdominal pain. Transverse ileal closure by Halsted end-to-end method, ileostomy above and reopening of appendicostomy on November 13, 1922, at Church Home and Infirmary. Imme-

HARVEY B. STONE

diate relief of pain, diarrhoea, and bleeding. No passage from colon except with salt solution irrigations.

BIBLIOGRAPHY

- <sup>1</sup> Paulus, R.: Muenchner Med. Wchschr., 1919, vol. lxvi, p. 233.
- <sup>2</sup> Lockhart-Mummery, P.: British M. J. Lond., 1920, vol. i, p. 497.
- <sup>3</sup> Klose, H.: Therap. Halbmonatsch. Berl., 1920, vol. xxxiv, pp. 281-286.
- <sup>4</sup> von Lippman, R.: Ibid., pp. 346-350.
- <sup>5</sup> Payne, R. L.: Va. Med. Monthly, August, 1922.
- <sup>6</sup> Halsted, W. S.: ANNALS OF SURGERY, Phila., vol. lxxv, p. 356.

## MESENTERIC THROMBOSIS\*

By JAMES F. MITCHELL, M.D.

OF WASHINGTON, D. C.

WHILE mesenteric thrombosis, or as it might more properly be called, mesenteric vascular occlusion, cannot be classed as a surgical rarity or curiosity, it may certainly be considered one of the most serious abdominal catastrophes with which the surgeon has to deal. Some five hundred cases have been reported, and these undoubtedly represent but a small proportion of the actual number. My own personal experience is limited to four, of which the last, presenting unusual difficulties and resulting in recovery, seems worth discussing and recording.

*Case Report.*—The patient, a previously healthy athletic girl of twenty, was seen on August 13, 1921. Except for some indefinite digestive disturbances and a mild anæmia there was no history of past trouble. The note states that yesterday she climbed a mountain, otherwise there was no history of trauma or any unusual exertion. This morning she went shopping, came home, ate her lunch and about two o'clock was seized suddenly with violent epigastric pain. The pain continued throughout the afternoon and grew worse. It has been constant and not crampy. She has vomited frequently. She has been given soda, brandy and other household remedies, all of which she vomited.

Examination about eight o'clock at night showed a patient looking distressed and complaining of violent epigastric pain and nausea. Pulse 72, temperature 98.2. The abdomen is natural looking, respiratory movements present and everywhere free. There is no distention or fulness. On palpation there is nowhere tenderness or rigidity and no mass can be felt. An enema resulted in a good normal movement, with solid fecal material and gas, giving considerable relief. The leucocyte count at 9 P.M. was 21,000. The condition at this time suggested the possibility of a mild acute appendicitis, although the leucocyte count seemed high. At midnight the temperature was 98.2, pulse 72. There seemed no indication for immediate interference. She was therefore given  $\frac{1}{8}$  grain of morphia and all food by mouth prohibited.

August 14, 1921. She had a very comfortable night, slept some and has had no further vomiting. At eight o'clock this morning her temperature was 98.2, pulse 72. The abdomen seemed a trifle full, but there was still no rigidity and no tenderness. In the suprapubic region there was a distinct feeling as of something filling the pelvis; but there was no dullness on percussion, no tenderness and no rigidity. At ten o'clock the leucocyte count was 21,000 and her condition about the same. At noon, although the temperature was still normal, her pulse had risen to between 110 and 120. The abdominal condition was unchanged. She still had constant epigastric pain but no nausea and no vomiting. The condition suggested some grave intra-abdominal lesion, not inflammatory, and while a circulatory disturbance was considered, it was rather felt to be an ovarian cyst with twisted pedicle. The rising pulse with a suggestion of shock made further delay seem unwise and she was taken to the hospital for operation which was finally done at three P.M., about twenty-four hours after onset. The patient took her anæsthetic well and went to sleep quickly requiring very little

---

\* Read before the Southern Surgical Association, at Memphis, Tenn. December, 1922.

ether. Her pulse was 120 when she was placed upon the table. The incision was about to be made when she suddenly stopped breathing. The pulse was imperceptible, pupils widely dilated and she was deeply cyanosed. Artificial respiration was given for several minutes before there was any voluntary breathing. Her color improved as her breathing became better; but the pulse remained exceedingly rapid and she was beginning to move on the table. On placing the ether cone over her face to resume the anæsthetic, she again stopped breathing and artificial respiration was again necessary. The pulse as nearly as could be counted at this time was 180. She was stimulated and given salt solution subcutaneously and without any further anæsthetic an incision was made from umbilicus to pubes, her movements being restrained by nurses holding the hands and feet. The ether cone was never placed over her face for the remainder of the operation, a few drops of ether being administered from time to time through a piece of gauze when her struggles became too violent, and throughout the whole operation less than a quarter of a pound of ether was used. Immediately upon opening the abdomen there escaped a great quantity of bloody fluid and there presented a large black coil of small intestine about seven centimetres in diameter, lying just above the pubes. The incision was enlarged to the left of the navel as it was evident that room would be required, and retraction was impossible because of the lack of relaxation of the abdominal muscles. The coil of intestine was delivered and was found to consist of eighteen inches of ileum, extending from the ileocæcal valve upwards. The appendix was not involved in the process and appeared normal. The mesentery corresponding to the involved coil was very thick, œdematous, and infiltrated with blood. No pulsation could be felt in the mesenteric vessels. The serosa over the coil was cracked in places, suggesting impending perforation, and the bowel was filled with fluid and gas. In spite of the bad condition of the patient it was evident that the only possible chance lay in immediate resection. There was no evidence of any twist or obstruction in the mesentery and the line of demarcation was sharply drawn at both extremities of the coil, the involved area extending exactly to the ileocæcal junction. A crushing clamp was placed across the end of the cæcum about one inch beyond the lower limit of gangrene and another on the ileum at the same distance above the upper limit and linen ligatures were rapidly tied in the crushed areas. The bowel was burned across with a cautery between the ligatures and clamps, the mesentery ligated with catgut and the whole involved coil removed. The ends of cæcum and small intestine were turned in first with a purse-string suture of linen and secondly with a similar one of chromic catgut. A lateral anastomosis was made with an outer stitch of linen and an inner one of chromic catgut. The omentum was turned down over the anastomosis and the abdomen closed. A gauze and rubber cigarette was left in the lower angle of the wound extending to the peritoneum. The patient was in an extremely poor condition at the end of the operation which, with its various interruptions, had consumed nearly two hours. Her pulse was about 180, and she was in marked shock. She reacted quickly, but was in rather serious condition for forty-eight hours. Her wound healed *per primam* and she made a rapid recovery, and was walking in three weeks. She is now, December, 1922, in excellent health and the only noticeable effect of the operation is that she has been inclined to have several movements daily, a condition which has been somewhat controlled by the administration of bismuth. A recent X-ray examination of the alimentary canal shows no abnormality and nothing to indicate any changed relations. It was thought that the frequent movements might be due to an unusually large opening between ileum and cæcum allowing the fluid contents of the ileum to pass on too rapidly. However, Doctor Christie who made the fluoroscopic examination reports that the bismuth meal progresses throughout at the ordinary rate.

This case presents several points of interest which will be taken up in the general discussion of the subject.

Mesenteric thrombosis is of particular interest because of its gravity, the difficulty of diagnosis, and the poor results of surgical treatment.

Pathologically, the occlusion may be either venous or arterial, or both vessels may be involved. Venous occlusion is less dangerous than arterial and is less frequent, occurring in about 40 per cent. of cases. It is due in most instances to a descending thrombosis, or may be in itself a primary affair due to some infectious process in the intestine, most frequently appendicitis. Arterial occlusion occurring in about 60 per cent. of cases is usually attributed to arteriosclerosis, endocarditis or to some infectious process elsewhere. This explanation will answer for those cases where the catastrophe occurs in the course of or following some infection or surgical condition. There are many instances, however, where no explanation can be given for the source of the embolus which has caused the obstruction. Such was the case under consideration; for the patient had no history of infection or trauma or any other condition which might explain the liberation of an embolus. As a matter of fact the majority of cases which come into the hands of the surgeon are of this type, and this fact possibly offers a partial excuse for the extreme infrequency of a pre-operative diagnosis. The superior mesenteric artery is occluded more frequently than the inferior, the usual explanation being that its diameter is nearly three times as great as that of the inferior; that it arises from the aorta at a higher point than the inferior, thus having an earlier opportunity of intercepting an embolus; and that its course is nearly parallel to that of the aorta, while the inferior runs off at an acute angle. The result of the occlusion is usually a hemorrhagic infarct, a pathological condition which has never been satisfactorily explained, except that while the superior mesenteric artery is not anatomically a terminal or end artery, it nevertheless is so physiologically. Ischæmic infarction is extremely rare. The amount of bowel involved depends upon the location of the occlusion. The terminal portion of the ileum is supplied by a single branch of the ileo-colic artery, an area which about corresponds to the involvement in our case. The loop of bowel supplied by the occluded vessel becomes engorged with blood, appearing greatly thickened and distended with gas and fluid. Peristalsis is decreased or entirely absent and there exists practically a paralytic ileus. Untreated, the condition goes on to gangrene and perforation, unless the area is extremely small, when circulation may be reëstablished, a condition which probably occurs much oftener than is suspected after abdominal operations. The mesentery becomes œdematous and infiltrated with blood to such an extent as to interfere with motility of the intestine. This was most striking in the case under discussion, the mesentery being two or three centimetres in thickness.

The early symptoms of mesenteric thrombosis are practically those of any intra-abdominal catastrophe. They vary according to whether the case is a primary fulminating one or of the secondary type appearing as a compli-

cation of preëxisting disease. Pain of sudden onset, severe and agonizing, is the most striking and the earliest symptom. Its location varies according to the point of occlusion or it may be generalized throughout the abdomen. It is most often about the navel or in the epigastrium. It has been explained as being due to dragging on the mesentery from excessive peristalsis caused by obstruction in the affected loop. In our case through long periods of observation no peristalsis could be made out, even by careful auscultation with the stethoscope over the abdomen. It seems to me that a better explanation is that it is due to distention and œdema of the mesentery which we know to be so highly sensitive. In our case the pain was also constant, which would not be the case were it caused by peristalsis. It may be compared to the steady pain of an appendicitis due to infiltration of the appendicular mesentery. There is often tenderness and abdominal distention, both of which were entirely lacking in our case, but rigidity and muscle spasm are not seen except in the very late stages when there is peritonitis from perforation or passage of organisms through a gangrenous bowel. As the condition progresses the coil of intestine becomes more and more distended with fluid and gas, and may be felt as a tumor, and there may be dullness in the flanks from free fluid in the peritoneal cavity. A more constant finding is a feeling of resistance to palpation, as in the present instance, which does not amount to the sensation given by an actual tumor. Vomiting is a marked disturbance simulating the picture of intestinal obstruction. It tends to decrease after the first few hours, thus suggesting that it is reflex rather than due to a complete obstruction. The vomitus may contain blood, but rarely becomes fecal. There is usually complete absence of voluntary bowel movements from the onset, and it is difficult to obtain a satisfactory movement, although complete obstruction is most unusual. In rare cases there is diarrhœa with bloody stools. In the present instance there was frequent and severe vomiting without any blood during the early hours. This ceased entirely following an enema given seven hours after onset. There was no diarrhœa and an enema resulted in a normal movement without blood. There is no rise of temperature except in the late stages. The pulse is striking and sooner or later leads one, as in the present instance, to suspect some grave intra-abdominal vascular disturbance. The pulse becomes rapid and small as the condition is well established. With the pallor and often cyanosis of the skin, normal or subnormal temperature, there is presented a well-marked picture of shock. It is said that there is a rapid drop in hæmoglobin due to the loss of blood into the infarcted area. Little has been said of leucocytosis which in our case was 21,000, although this count is not unusual with any type of intestinal obstruction.

The extreme variations in the symptoms and clinical picture account for the frequent failure in diagnosis. In the present instance the possibility of ovarian cyst with twisted pedicle was considered and, I must confess, that mesenteric thrombosis did not occur to me. Intussusception, volvulus or some other form of mechanical obstruction is difficult to differentiate, as is

also acute pancreatitis; and the conclusion reached by the surgeon is that there is some lesion associated with the intra-abdominal vascular system which demands operative interference. Loop emphasizes the point that it is a mechanical, as contrasted with an infective process, a fact which should be an aid to diagnosis in the early stages. Occasionally the diagnosis is made before operation.

In the four cases which I have personally encountered, the first was operated upon for abdominal symptoms in the course of typhoid fever, an intestinal perforation being suspected. The symptoms proved to be due to a very extensive ascending thrombosis which involved the mesenteric vessels. Practically the whole intestine was involved and death rapidly resulted. The second case, a male, aged forty-one, was seen at the Johns Hopkins Hospital in July, 1900, having been suffering severely for four days with agonizing pain just to the left of the umbilicus. He had had frequent vomiting and no passage of the bowels for two days before admission. His temperature was 102°, pulse 140, respiration 31; skin cold and clammy; lips and mucous membranes pale, abdomen distended uniformly and tender on pressure especially on the right side. There was dullness over the right lower abdomen extending nearly to the median line; no visible peristalsis. The general aspect of the man strongly suggested a severe intra-abdominal hemorrhage. A diagnosis of mesenteric thrombosis was made and immediate operation advised. The peritoneal cavity contained a large quantity of bloody fluid, and a large distended blue-black coil of small intestine was found filling the right side of the abdomen. The mesenteric arteries were thrombosed. Intestine amounting to 275 cm. was excised, the ends being brought out on the abdominal wall. An anastomosis was not done because of the extremely grave condition of the patient. He died seven hours after the operation. No autopsy was permitted and the exact location of the coil of small intestine was not determined. As I remember it, the diagnosis was made because of the history of obstructive symptoms, the general shocked appearance of the patient, and the dullness in the right side of the abdomen, his whole condition giving the impression of a grave intra-abdominal vascular lesion. The third case, seen in the last year, was a man aged fifty who was brought into the Emergency Hospital in a moribund condition with a history of three days illness, characterized by sudden onset of intense abdominal pain with continuous vomiting and subnormal temperature. He was in extreme shock, cyanosed, cold and clammy. He presented much the same picture as the second one and mesenteric thrombosis was suggested as a possible diagnosis. He failed to react to heat and stimulation and died in an hour or two, no operation being attempted. Autopsy showed mesenteric arterial thrombosis with involvement of several feet of lower small intestine. Thus in our four cases the diagnosis of mesenteric thrombosis was properly guessed in one and suspected in a second. Finney reports an interesting case in a patient who had suffered for years with Reynaud's disease and had been in the hospital many times for treatment. She suddenly developed abdominal symptoms in the course of a severe attack and came into the hospital with a diagnosis of acute intestinal obstruction. Finney made a diagnosis rather jokingly of mesenteric thrombosis, operated, and found three feet of ileum just above the ileocaecal valve involved. He did a resection and she made a good recovery.

In regard to treatment, it is naturally surgical. Operation at the earliest possible moment with immediate resection of the affected area with a safe margin of healthy bowel offers the best chance of recovery. The results,

however, are disappointing from a statistical point of view, the mortality in operated cases being variously estimated from 75 to 90 per cent. Klein, in an excellent article last year, stated that about twenty-four successful resections had been reported since Elliott's first case in 1895. Undoubtedly they are not so uncommon, for in the discussion of Mason's paper before this Society last year three successful cases were added to his, and McGuire has recently reported two more brilliant results. In a paper by Ross it is stated that in the records of the Lankenau Hospital in Philadelphia during a period of ten years, in 30,000 surgical cases there were only two of mesenteric thrombosis. He reports five cases of which one recovered after operation. In this patient operated upon by Deaver there was found a thrombosis involving a segment of ileum, the amount not noted. The bowel was in fair condition and the abdomen was closed without resection. In the discussion of this paper Peck reported two cases of probable mesenteric thrombosis. In the first case the amount of intestine involved was so extensive that resection was not considered. He did a cæcostomy for the purpose of irrigating and the patient recovered. In the second case where the question of thrombosis was uncertain, but the intestine dark and swollen without discoverable cause, it was simply returned and the abdomen closed with subsequent recovery. These cases would seem to show that in some instances the involved bowel may be taken care of by collateral circulation, or that there may possibly be an incomplete obstruction of the vessels, so that the bowel is capable of restoration of circulation and function. It is probable that many post-operative abdominal disturbances may in reality be due to temporary or incomplete occlusion or to the blocking of a small branch of the mesenteric the function of which is quickly assumed by collateral circulation. Klein reports in detail nine cases in which there was a probable diagnosis of mesenteric occlusion, all of which recovered spontaneously. This, nevertheless, does not affect the rule that with acute symptoms and a suspected diagnosis of occlusion of the mesenteric vessels, the only rational procedure is abdominal exploration.

A feature of the sequelæ in the case herewith reported has been the frequent bowel movements, which might be explained by the free anastomosis between small intestine and cæcum with the elimination of the ileocæcal valve. The removal of eighteen inches of small intestine would not seem to be sufficient to have an etiological influence and there has been no disturbance of nutrition.

As it is sometimes necessary to remove a large section of intestine in order to make an anastomosis in healthy tissue, it is interesting to consider just how much can be taken away with a chance of recovery and what may be expected later in the way of interference with metabolism and nutrition. This subject has been carefully studied by Flint who collected from the literature fifty-eight cases in which more than 200 cm. of small intestine had been removed. Of these, forty-nine survived the operation. The greatest amount resected was 540 cm. in a case of strangulated hernia reported by Brenner.



This patient apparently recovered with little disturbance of nutrition, but died two and a half years later of inanition.

The clinical manifestation of the metabolic disturbance consists largely of a diarrhoea, usually slight, with two or three soft or fluid movements a day. The stools show inability to absorb fat. In other cases the diarrhoea is of a fulminating character and may contribute actively to a fatal outcome. Another type of reaction is shown when the patients recover temporarily, but suffer from such profound limitation of the power of absorption that they die later, as in Brenner's case. Experiments on animals show that there is a compensatory hypertrophy, as well as hyperplasia of the remaining portion of the small intestine. Flint concludes that in humans as in animals about 50 per cent. of the small intestine may be removed without much danger of serious consequences in the majority of cases. The resection of smaller amounts may, however, be followed by severe metabolic disturbances, and even inanition and death. The metabolic disturbances bear no definite relationship to the amount of small intestine resected. Resections of over 400 cm. have recovered while death from inanition has resulted from the removal of 284 cm. and profound digestive disturbances from the resection of 192 cm. of ileum. The surgical rule then is to resect always as little of the intestine as the pathological condition will allow. The metabolism of patients who have undergone extensive resection should be aided by a rich and easily assimilated diet, poor in fats and relatively rich in carbohydrates.

#### REFERENCES

- Loop: Jour. A. M. A., 1921, vol. lxxvii, p. 369.  
 Finney: Trans. Am. Surg. Assoc., 1920, p. 401.  
 Ross: ANNALS OF SURGERY, 1920, vol. lxxii, p. 121.  
 Klein: Surg., Gyn. and Obst., 1921, vol. xxxiii, p. 385.  
 Mason: Trans. South. Surg. Assoc., 1921, p. 348.  
 Flint: J. H. H. Bull., 1912, vol. xxiii, p. 127.

## SARCOMA OR EMBRYOMA OF THE KIDNEY IN INFANTS\*

BY CHARLES R. ROBINS, M.D.

OF RICHMOND, VA.  
STUART CIRCLE HOSPITAL

THE type of tumor referred to in this paper is that of the rapidly growing tumor of the kidney found in infants and very young children and evidently of embryonic origin. These tumors have always been of interest and have been the subject of considerable study and investigation. Clinically they have commonly been referred to as sarcoma of the kidney in infants, but histologically they have been described by a number of names, depending on the histological elements found. The first attempt to separate these embryonal tumors into a class by themselves and differentiating them from other kinds of growths, was made by Birch-Hirschfeld in 1894, and since then they have been studied and reported by various observers who have also advanced theories as to their origin. An unanimous opinion on this point has apparently not yet been reached. They are, however, always embryonal in origin and are the result of inclusion.

The confusion in the nomenclature has been due not only to the variety of tissues found but to the findings of both epithelial and mesoblastic elements. The most interesting structures are the rudimentary tubules and glomeruli. The tubules are often quite definitely formed and show a lumen lined with cuboidal cells and with a basement membrane. The most frequent tissue found and most predominating is the proliferating connective tissue which usually forms the stroma of the tumor and in which the other structures are situated. In addition to these characteristic constituents there may be found striped and smooth muscle fibre, cartilage, fat, bone, collections of epithelium, and a rudimentary substance from the nervous system. However, all of these tumors, whatever may be the predominating tissue, are evidently of the same origin, present the same history and characteristics and contain both epithelial and mesoblastic elements. They are therefore referred to as mixed tumors. In those cases where one element only is reported, the examination is doubtless incomplete. These tumors are usually rapid in growth and reach a very large size, often completely filling the abdomen of the infant before they are brought to the surgeon. They are usually smooth and globular in shape and the average size at the time of removal is that of a grape fruit. They usually occur in the substance of the kidney and the growth is expansive, displacing the normal kidney structure but not infiltrating it. The kidney tissue that is pressed upon atrophies, but the balance of the kidney retains its normal shape, appearance and function, and usually presents itself as a nubbins projecting from the periphery of the tumor. The tumor apparently presents a very definite capsule which, however, is adventitious. Metastases are relatively infrequent and the lymphatics are almost never involved. Notwithstanding this these tumors have

---

\* Read before the Southern Surgical Association, Memphis, Tenn., December, 1922.

been found to be intensely malignant with a high rate of primary mortality from operation and a high rate of recurrence, so that a total mortality rate including that of operation and recurrence has been reported as high as ninety-three plus per cent.

Recently, Loughnane, quoted by Mixer, reports, of thirteen personal nephrectomies, there was one death from operation only and the late results were: Results unknown, three cases; survived three years or more, four cases; alive and healthy two and one-half years after operation, two cases; died from inter-currence of phthisis within three months, one case. This is the most favorable

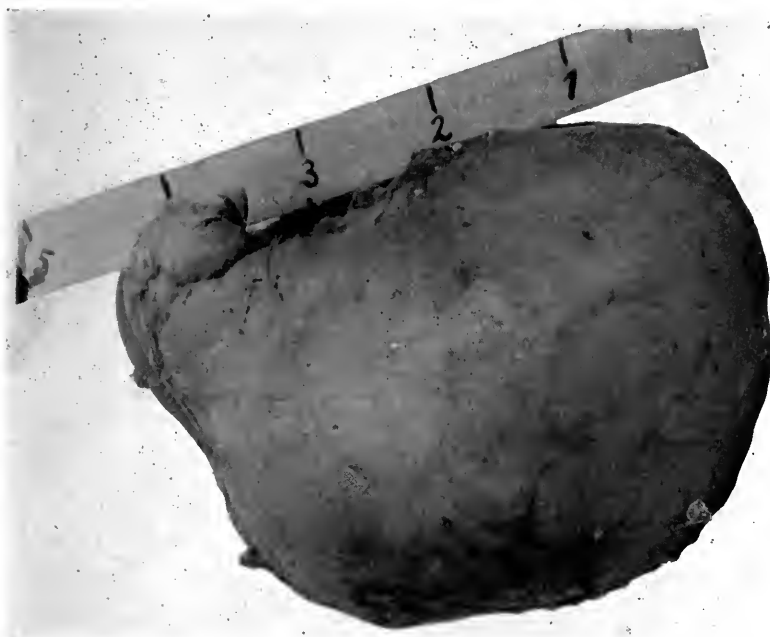


FIG. 1.—General appearance of tumor growing in lower pole of kidney with a perfectly normal upper pole.

group of results that I have been able to collect, and is I think unusual. It may be that the cases were detected and operated at a very early period or the cases may have been selected for operation. However, other reporters who have had cases to survive have found that this has taken place in advanced cases also. In the cases reported by Mixer there was an operative mortality of thirty-five per cent. in fourteen nephrectomies and nine survivals, and of these all showed rapid recurrence and death except one who was alive and well three and one-half years following nephrectomy. The symptomatology is quite different from that of malignant disease of the kidney in adult life. Hemorrhage is quite infrequent and urinary findings are negligible. This is quite easily understood when the tumor is examined. It is a tumor in the kidney and not of the kidney and that portion of the kidney which is not affected by pressure is perfectly normal. The patient is usually somewhat anæmic looking, usually suffers to

some extent from digestive disturbance but there are no characteristic or pathognomonic symptoms, and the diagnosis of the case is involved in finding the tumor. This is usually quite accidentally discovered by the parent. The tendency for children to have enlarged abdomen in various conditions as a rule prevents the parent from suspecting a serious condition, and the absence of symptomatology does not suggest the calling in of a physician until the disease is well advanced. The majority of these cases undoubtedly are discovered in children's hospitals where routine examinations are made of all cases. As to the outlook in this condition, it would appear that better results may be secured. If the family physician and pediatrician are on the outlook for them they will doubtless be discovered when the tumor is still small and before the general health of the patient has been affected.

Radiation has accomplished so much in other conditions that it should be of great value in this. The complete removal of the tumor in favorable cases with subsequent radiation should give better ultimate results. The diagnosis depends on finding the tumor, which is usually of firm consistency, globular and of regular outline, with a certain amount of mobility in operable cases and which can be traced to the kidney region. Should doubt exist as to the nature of the tumor, ureteral catheterization and a pyelogram will be of great value.

My own experience is limited to four cases, only one of which will be reported. This case is of interest because the specimen gives a very typical example of the tumor and because the patient is still alive and in robust health after the operation.

*Case Report*:—Number 26-7. R. M. F., twelve months of age. Male. Patient referred on January 4, 1921, on account of a lump in the right side of his abdomen. His mother stated that his abdomen had always looked full but she had not noticed any lump in it until three days ago when it was noticed when the baby was on its father's lap. The baby does not seem to suffer any discomfort, has always been hearty and bowels normal, but has looked rather delicate. He had been suffering from a suppurating middle ear, but his mother said that he appeared to be picking up some and she had not noticed any loss of weight. She had not noticed anything abnormal about his urine.

On examination the patient was found to be rather pale looking with prominent veins. The abdomen was distended and in the right side of the abdomen a globular tumor was found nearly filling the entire abdomen. It could be palpated posteriorly in the right kidney space and flank and seemed to be somewhat attached at this point although freely movable. The pelvis and subcostal region appeared to be clear and the tumor projected anteriorly. A diagnosis of sarcoma of the kidney was made and operation advised which was done two days later.

The incision was made in the semilunar line and on opening the abdomen the ascending colon and small intestine were found displaced to the left by the growth of the tumor. The peritoneum was incised external to the ascending colon and the kidney removed from its bed without difficulty. The pedicle was isolated and the vessels and ureter ligated separately. At the lower pole of the kidney an aberrant artery and vein were found to enter. These were ligated separately. There was comparatively little bleeding and this was easily controlled, the peritoneum was sutured and the abdominal wound closed without drainage.

## SARCOMA OR EMBRYOMA OF THE KIDNEY IN INFANTS

The tumor was about the size of grape fruit and sprang from the lower pole of the kidney, the upper portion of the kidney being quite normal. A number of vessels radiated from the hilum to the periphery of the tumor. The patient stood the operation very well and was only slightly shocked. Following the operation his temperature went up gradually until it reached 102, where it remained until the eighth day following the operation when it dropped suddenly. In the meantime he had developed a discharge in his left ear, which had previously been infected. This apparently accounted for the temperature. He was discharged from the hospital two weeks after the operation, apparently in excellent condition, and three months later his mother wrote that "the baby is doing lovely. He had some trouble with his ear for a while but made a complete recovery. He sleeps fine, is real fat and crawls any and everywhere." In October of this year she wrote me that he had a double pneumonia in the spring and had been very ill but had



FIG. 2.—Specimen split open. Upper pole and pelvis normal. Apparent capsule made of displaced and thinned kidney substance and kidney capsule.

recovered from that. A week later she brought him to my office where I made an examination and found him in excellent health, his wound nicely healed and no evidence of any tumor or swelling.

The following is the report on the tumor, made by Dr. Ward H. Cook, Professor of Pathology in the Medical College of Virginia:

"S-22-546.—Specimen received in Kaiserling's fluid No. 1 in which it has been preserved since January 6, 1921.

The specimen consists of an ovoid tumor 11 x 8 x 7.5 cm. which occupies the lower pole of a small lobulated (infantile) kidney (Fig. 1). Excepting perhaps in the thinned lower tip of the organ, the tumor is definitely encapsulated by fibrous tissue which is continuous with the capsule of the kidney. The tumor tissue is softer than the kidney substance, is faintly lobular but otherwise homogeneous in the upper portion, marked by a wedge-shaped fibrous septum mesially, soft and friable laterally, and contains large rounded masses of soft thready consistence in lower third. (Fig. 2.)

*Microscopic.*—Sections are examined from every portion distinctive in gross appearance. These show a lobular tumor, the lobules of which vary greatly in size and form. The larger lobules consist of short, closely set, spindle-shaped cells indistinctly separated into small groups by vascular spaces of capillary structure and delicate, twisting strands of fibrous tissue. Occasionally within such groups there is perfect epithelial differentiation in the form of tubules of single-layered cuboidal cells and glomerular structures composed of vascularized plugs of fibrous tissue, somewhat lobulated, covered by low cuboidal cells and projecting into a dilated tubular structure. Other cell groups show epithelial differentiation less perfect, both as regards convoluted tubules and glomeruli, yet definitely indicated.

Other lobules consisting of small rounded cells with relatively large deeply staining nuclei show a similar tendency. Some of the cells, having developed more cytoplasm, are to be seen in rosettes which occasionally are found with a definite lumen, thus assuming an acinar structure. The epithelium-like cells which make up such acini are sometimes in two or even three rows. Still other areas of the tumor exhibit small, more widely separated lobules, each of which contains what appears to be a rudimentary structural unit of the renal cortex. The formation of glomeruli is a striking feature. Mitotic figures are of frequent occurrence throughout the tumor. Careful search fails to reveal either smooth or striated muscle fibres.

The tumor is evidently derived from a portion of the anlage of the metanephros which has retained its embryonic character and growth activity. It is producing epithelial and connective tissue elements and probably also endothelial structures. Diagnosis: Mixed tumor of the kidney."

## SPONTANEOUS HÆMATOMA IN SARCOMA OF KIDNEY\*

By FRANK K. BOLAND, M.D.

OF ATLANTA, GEORGIA

MANY cases of rupture of organs without an external or penetrating wound have been reported. The liver, spleen, kidney, stomach and intestines have been ruptured in this manner. Of all organs exposed to such an injury the kidney appears to be the most susceptible. Küster,<sup>1</sup> Herzog<sup>2</sup> and others have recorded several cases; the writer has reported three.<sup>3</sup> Küster<sup>4</sup> believes that such rupture is due to hydraulic pressure within the kidney. Other writers attribute the injury to pressure of the distended kidney against the transverse processes of the vertebræ, or to the pressure of the ribs or the diaphragm or other muscles. Severe muscle strains from pulling, jumping, lifting an heavy object or a sudden twist of the body have been mentioned as causes.

If such factors as these may rupture a normal kidney, it is not remarkable that a diseased kidney might burst from less force or from no apparent extra-renal force at all. A few cases of spontaneous rupture of pathological kidneys are to be found in the literature. It is not believed that a perfectly normal kidney could rupture spontaneously. Wunderlich<sup>5</sup> described the condition in 1856 and called it spontaneous apoplexy into the capsule of the kidney. Lippens,<sup>6</sup> in 1913, collected twenty-three cases, two of which were bilateral, and Wade,<sup>7</sup> in 1915, stated that thirty cases had been reported.

The common underlying pathological cause has been acute or chronic nephritis. The case described by Thomas<sup>8</sup> occurred in an hydronephrotic kidney filled with stones. In some instances an hæmatoma has formed under the capsule of the kidney, but usually the capsule ruptures and blood escapes into the perirenal fat, producing a large hæmatoma.

The present case is spoken of as spontaneous hæmatoma instead of spontaneous rupture because the hæmatoma, on account of its enormous size, was the outstanding picture rather than the comparatively small rupture. The case is unique for two reasons: First, because the writer has been unable to discover in the literature the report of a similar condition occurring in a neoplasm of the kidney; and second, because the rupture of the kidney and formation of the hæmatoma were the first signs of the disease manifested in the case. Previous to this time the patient had been in good health, and presented no symptoms which would lead one to suspect her of having anything wrong with the kidney. Apparently the rupture occurred early in the course of the disease.

---

\* Read before the Southern Surgical Association, Memphis, Tenn., December 13, 1922.

*Case Report.*—The patient was white, female, fifty-one years old. Two children, the youngest seventeen. Her past history negative, except several years ago she had a vaginal hysterectomy for prolapsus with satisfactory results. At ten A.M., August 23, 1922, while walking, she was seized with a sudden violent pain in the left loin, accompanied by extreme weakness, faintness and nausea. She was taken home and seen by her physician within two hours of the onset of the condition. He found her in a state of collapse, with a very weak pulse, a distended abdomen, and an easily discernible mass in the left loin. She was then vomiting and on account of this symptom, and the distention, his first thought was of intestinal obstruction. High enemata, after several trials, gave a large evacuation of fæces and gas, and the general condition of the patient improved. Six or eight hours later she relapsed into her previous critical condition, and the mass in the loin had reached its maximum size. The pain was still very severe, and morphia was given. The abdominal distention recurred, and was relieved with difficulty.

It was not known whether the patient voided urine while expelling the enemata, but twelve hours following the beginning of the attack eight ounces of urine were obtained by catheter. This specimen was perfectly clear, acid, with a specific gravity of 1026, no albumen, sugar, pus, nor blood, and no other abnormal elements except a few hyaline casts.

The patient was first seen by the writer thirty hours after she was taken sick. She was then markedly distended, and a high colonic irrigation brought away much gas and the dark fluid from previous injections. She had passed about twenty ounces of urine since the trouble first began, and the examination of a second specimen was also negative for abnormal constituents. She drank some water and had perspired profusely. Any movement of her body brought on nausea. Her pulse was 90, regular and weak; respiration 20 and shallow; temperature  $99\frac{1}{2}$ . Blood count showed 8000 leucocytes. Heart and lungs negative. No swelling of the extremities. Pelvic examination threw no light on the condition.

The mass in the left loin was the size of one's head and extended toward the pelvis. It was tender, hard and immovable. Gentle inflation of the descending colon with air showed that the mass was retroperitoneal; it could not be the spleen, therefore it must be the kidney or about the kidney. The case gave one the impression of a hydronephrosis, due to the sudden kinking of the ureter or blockage by a stone. There was no X-ray equipment available, and the weakness of the patient and difficulty of moving her seemed to contra-indicate the use of the cystoscope. A kidney functional test was not performed. The acuteness and severity of the condition, without any previous history as a guide, called for an exploratory operation.

Under ether anaesthesia a posterior oblique incision was made over the left kidney. The mass proved to be the kidney, its lower pole enveloped by an hæmatoma 22 cm. in diameter, apparently held within the perirenal fat. The whole was easily loosened and delivered, with but very little bleeding. Hemorrhage from the kidney seemed to have stopped. It was observed that a new growth, 7 cm. in diameter, probably malignant, occupied the lower third of the organ. The remaining two-thirds, though normal in color and consistency, seemed to be shrunken, and the renal vessels and ureter smaller than usual. From this it was inferred that the kidney was performing but little function. A nephrectomy was done since the patient's previous good health warranted the belief that the other kidney was excreting normally.

Examination of the excised organ showed that it had "blown out" at its lower pole through the new growth, producing hemorrhage and the enormous



hæmatoma. What excited the rupture at this particular time could not be determined. It could not be proved that a large vessel had become invaded by the growth. The pathological diagnosis of Dr. John Funke was spindle-cell sarcoma. On account of the fatty tissue found in the growth he thought it might have started as a lipoma.

The patient passed eight ounces of urine twelve hours after the operation, and the amount gradually reached normal. The urinalysis report a short time ago was negative, and recent skiagrams have failed to show any metastases. She has received several exposures to deep X-ray therapy, and her condition to-day seems excellent. In the presence of malignant neoplasm, rupture of the kidney was considered a fortunate circumstance since it called attention to a condition which otherwise would not have been recognized until it was much further advanced.

## BIBLIOGRAPHY

- \* Küster: Die chirurgischen Krankheiten der Nieren. Stuttgart, Enke, 1896-1902, vol. cxxiii, 721 p. Lfg. 52b, Deutsch, Chirurg.
- \* Herzog: Ueber Nierenverletzungen, Munch. med. Wchschr., 1890, vol. xxxvii, pp. 198, 219.
- \* Boland: Traumatic Rupture of the Kidney; Report of Three Cases. Southern Medical Journal, October, 1913.
- \* Küster: Zur Entstehung der subcutanen Nierenzerreissungen und der Wanderniere. Arch. f. klin. Chir., 1895, vol. i, pp. 676-86.
- \* Wunderlich: Modern Surgery, DaCosta, Eighth Edition, p. 1433.
- \* Lippens: Jour. de Clin., 1913, vol. xi, I.
- \* Wade: Spontaneous Rupture of the Kidneys, with Secondary Perirenal Hemorrhage, in Acute Toxic Nephritis. Jour. Med. Research, 1915, vol. xxxii, pp. 419-31.
- \* Thomas: Spontaneous or Non-traumatic Rupture of the Left Kidney. The Journal-Lancet, Feb. 1, 1917.

## URETERAL INJURIES DURING PELVIC OPERATIONS\*

By JOHN M. MAURY, M.D.

OF MEMPHIS, TENN.

ACCIDENTAL injury may occur to one or both ureters and may be inflicted with ligature, clamp or scissors.

*Ligation.*—Events developing subsequent to ligation depend upon whether one or both ureters are ligated and the length of time elapsing before remedial measures are instituted. Unilateral ligation done accidentally, provided the other kidney is sound, usually passes unnoticed. The other kidney silently takes upon itself the function of both or, at most, there is no more evidence clinically than tachycardia with pain and tenderness over the loin of the affected side (Robinson),<sup>1</sup> Judd,<sup>2</sup> Frankenstein,<sup>3</sup> and others have taken advantage of this fact to deliberately ligate and drop one ureter in operating upon cancer of the bladder involving one ureteral orifice when it was found inexpedient to implant the resected ureter into the bladder. In rare instances anuria has resulted from reflex suppression after ligation of one ureter, as in a case mentioned by Robinson<sup>1</sup> in which decapsulation of the sound kidney restored function. If infection already exists it will nearly always be necessary to remove the kidney.

The results of ligation are manifest in the kidney, the ureter above the seat of ligature, and in the ureter at the point of application of the ligature. Animal experimentation has shown that dilatation of the ureter and pelvis of the kidney begins at once after ligation, with progressive impairment of kidney function until at the end of four or five weeks the kidney is functionless. Up to a certain point in the progressive damage which is taking place in the kidney, release of back pressure by nephrostomy or deligation may result in restoration of function to normal. The time within which restoration to normal may occur is set by Johnson,<sup>4</sup> from animal experiments, at two weeks from the time of ligation.

It is probable that this is at least approximately true in man, for in a case reported by Caulk and Fischer,<sup>5</sup> in which both ureters were ligated, double nephrostomy on the eighth day was followed by complete restoration of function, and there are other cases reported of return to normal function after a shorter period of occlusion.

The damage done locally by the ligature may vary in degree from slight trauma, quickly repaired, to complete occlusion by cicatricial formation at the point of injury. The amount of damage seems to be directly proportionate to the length of time the ligature remains in place. In animal experimentation, where the ureter is isolated and tied, greater damage results than after accidental ligation during operations where more or less of surrounding tissues are included in the ligature. This is proven clinically by many reported cases

---

\* Read before the Southern Surgical Association, at Memphis, Tenn., December, 1922.

## URETERAL INJURIES DURING PELVIC OPERATIONS

in which prompt loosening of the ligature has resulted in immediate and permanent restoration of ureteral function.

Kolb<sup>6</sup> removed a ligature, accidentally applied, after twenty-four hours and at autopsy shortly after there was no evidence of necrosis at the point of ligature. Kroemer<sup>7</sup> reports two cases in which immediate loosening of the ligatures gave permanent relief.

Even complete cicatricial occlusion may not be permanent. In the article by Caulk and Fischer, above alluded to, the process of canalization after cicatricial occlusion following ligation in animals is beautifully illustrated, showing complete repair in six weeks; and in their case in which double nephrostomy was done on the eighth day after bilateral ligation, repair of the ureters was complete, with passage of urine by the bladder, on the fifty-eighth day.

*Clamping.*—Judging from what may be found in the literature, injury from clamping is a rather rare incident but, as one would suppose, results in greater damage over a larger area.

The injury resulting is either a necrosis with fistula formation or a more or less complete stricture, depending upon how long the clamps remain on.

Furness<sup>8</sup> mentions a case in which clamps were accidentally applied to both ureters, and though they remained on only seven or eight minutes both ureters sloughed, fistulae forming on the eighth and twentieth days.

In a personal experience the left ureter was accidentally clamped but immediately released. Had I then been aware of the result in Furness' case I would at least have considered the advisability of doing a resection with anastomosis. Nothing was done, however, and the patient made a good clinical recovery though it is possible and even probable that stricture formation resulted.

*Severance.*—Injury by the scissors means either a simple severance of the organ or the removal of a segment. Fortunately this injury is usually detected at once. Either there is an escape of urine which tells the tale or the severance of a tubular stricture of such size arouses suspicion which leads to an examination and detection of the injury. If not detected there results the usual signs and symptoms of urinary infiltration.

*Case Report.*—On November 3, 1921, E. R., a colored woman, was admitted to the Memphis General Hospital. Married five years, no pregnancies. Menstruation normal. Urine showed an occasional pus cell and an occasional granular cast, no albumin. Blood count normal. Wassermann negative. Physical examination was negative except for the presence of a smooth, solid tumor filling the lower abdomen and reaching within two inches of the ensiform. Pelvic examination showed the cervix high up posteriorly and the tumor almost filling the pelvis. Diagnosis; myofibroma.

Operation November 8, 1921. Realizing that the tumor in its growth had probably brought the bladder above its normal position, the abdomen was entered just below the umbilicus and the wound enlarged both upward and downward. On delivering the tumor, the bladder was at once seen to be spread out on its anterior surface, reaching upward to the umbilicus and well out on both sides.

Its walls were quite thin and so adherent to the fibroid that on stripping it down a rent two and a half inches long was torn in its summit. The uterus and broad ligaments were low in the pelvis and could not be reached until the last steps in the removal, but by rotating the tumor backward the cervix could be reached and the tumor removed from below upward.

Being fully aware of the fact that the ureters must lie in an abnormal position, every care was taken to prevent injury to them and only blunt dissection was employed until it was thought that they must be safe. Nevertheless, they were both cut in the last stages of the operation but at such a point that implanation into the bladder could be made without tension. Two lateral flaps were made at the end of each ureter by longitudinal incision three-eighths of an inch long dividing the anterior and posterior walls. After drawing the ureters through an oblique puncture in the bladder wall these flaps were bent outward and stitched to the mucosa with a single fine catgut suture. A single fine silk suture on the outside, going through muscularis and periureteral structures, served to fasten the bladder snugly around the ureter and prevent its being pulled out. The tear in the bladder made the implantation particularly easy. The bladder wound was closed and the operation completed in the usual manner. A urethral catheter was kept in the bladder for ten days.

Her convalescence was unusually smooth. The urine, which at first was bloody, soon cleared up and a cystoscopic examination before she left the hospital showed urine discharging from both ureters. No attempt was made to catheterize the ureters at that time but she was passing about forty-five ounces a day, sp. gr. 1016, acid and normal except for a faint trace of albumen and an occasional pus cell.

Three months later another cystoscopic examination was made by Doctor Cullings and the following report returned:—"Cystoscope introduced into bladder without difficulty. Bladder mucosa apparently normal except for several small areas at the base showing slight congestion, and a few small bits of pus membrane adherent to these areas. Natural ureteral openings normal in appearance except for a rather 'ironed-out' appearance. Catheter introduced into both right and left and passed up each about one inch. Both openings still show intermittent contractions.

"Artificial ureteral openings appear above on the post-bladder wall about one and one-half inches from original opening and are separated by a distance of about two inches. Each is marked by a small pedunculated body about the size of a B.B. shot. Right opening is situated just above the pedunculated body marking its location and is quite large. Left opening is located on the lower surface of the pedunculated body of that side and is very small, in fact so small that close inspection is necessary to identify it. There is an intermittent pulling in of both ureteral openings not unlike that of the normal, but no swirl of urine can be detected from either. Catheter passed up to right pelvis with ease. Urine discharged at normal rate at first but soon slowed down to an occasional drop. At first, discharge was intermittent as in the normal. Catheter could only be passed into the left ureter to a distance of one-half inch, where obstruction was met. Very small catheters and also very stiff ones were used in an effort to get by the obstruction but at no time could any of them be passed far enough to include the catheter eye. Phenolsulphonephthalein, 1 c.c. injected intravenously appeared in the urine of the right kidney in twenty-three minutes. I feel rather sure that this is not entirely accurate as the discharge of urine through the catheter was not normal at that time, having slowed down considerably. The phthalein output in two hours was 54 per cent."

## URETERAL INJURIES DURING PELVIC OPERATIONS

After injecting the right pelvis with 25 per cent. sodium bromide solution a pyclogram was made by Doctor Conly who reported that "The pelvis appears large, but in relation to the size of the calyces it is regarded as normal. The ureter does not appear at all dilated."

\* Blood examination showed urea nitrogen to be 35.28 and creatinin 2.36 mg. per 100 c.c.

Although during the operation every effort was made to prevent traumatic injury to the structures and the immediate result was perfect as shown by the cystoscopic examination two weeks after operation, the final result was a complete blocking of the left ureter, probably from cicatricial contraction one-half inch above the anastomosis, and impaired function of the remaining kidney as shown by the moderate retention of urea nitrogen and creatinin in the blood though the elimination of phthalein was normal.

*Treatment.*—The knowledge of accidental injury by ligation implies that both ureters have been tied. This, of course, means that the condition must be remedied or the death of the patient will result. The remedial measures which may be employed are five: (1) Removal of the ligatures. (2) Implantation of at least one ureter into the bladder. (3) Uretero-ureteral anastomosis on one or both sides. (4) Nephrostomy. (5) Severing one or both ureters and bringing the proximal ends to the skin surface.

In considering what remedial measures to employ, it must be kept in mind that the patient, in the near past, has already been subjected to a major operation and usually a serious one, because it is in the bad cases that the accident occurs. Removal of the ligatures is the procedure of choice and when done early there is good reason to expect a satisfactory result. It is more easily accomplished when undertaken before the organization of wound exudates has obscured the field. If for any reason there is delay, the least that one may expect is more or less complete stricture formation with incidental damage to the kidney, and simple deligation will not suffice. In order of choice, uretero-vesical implantation, uretero-ureteral anastomosis or nephrostomy may be employed. In the event of the patient's condition precluding the possibility of choice, the least time consuming procedure must be followed and this is nephrostomy. Double nephrostomy may be done in a few minutes with the expectation that absorption of the ligature and canalization will result in due course of time while the condition of the patient may make an anastomosis a formidable procedure. If canalization is not satisfactorily accomplished the patient is in good condition for anastomosis or implantation. Severing the ureter and bringing the proximal end to the surface has been employed, but one can hardly imagine conditions under which one of the other methods would not serve a better purpose.

Injury from clamping, when it is necessary to do anything, means that the injured area must be resected and the problem of repair is then the same as when the ureter is accidentally severed. Whether simple ligation above and below the seat of injury, uretero-ureteral anastomosis or a vesical implantation shall be done, will depend upon the choice of the operator, the location of

the injury and the condition of the patient. Peterson <sup>9</sup> recommends the invagination and the end in side methods as giving the best results of the various methods of anastomosis.

REFERENCES

- <sup>1</sup> Robinson: Brit. Med. Jour., May 7, 1921, p. 665.
- <sup>2</sup> Judd: S. G. O., vol. xxiv, p. 663, 1917.
- <sup>3</sup> Frankenstein: Gynack, Rundschau Berl. u Wein, 1914, vol. viii, pp. 431-435.
- <sup>4</sup> Johnson: Quoted by Caulk and Fischer.
- <sup>5</sup> Caulk and Fischer: S. G. O., vol. xxx, p. 343.
- <sup>6</sup> Kolb: Ztschr. f. gynak, Urol. Leipz., vol. xi, pp. 270-275, 1910-11.
- <sup>7</sup> Kroemer: Ztschar. f. Urol., Berl. & Leipz., 1909, Buheft, pp. 490-501, 1 pl.
- <sup>8</sup> Furness: Am. Jour. Obs. & Dis. Women & Children, vol. xxvii, p. 14.
- <sup>9</sup> Peterson, Reuben: Jour. So. Surg. Soc., 1920.

## TYPHOIDAL OSTEOMYELITIS\*

BY NATHAN WINSLOW, M.D.

OF BALTIMORE, MD.

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF MARYLAND

NOTWITHSTANDING 0.82 per cent. of all typhoid cases develop metastatic bone disease and 0.45 per cent. of all osteomyelitic lesions are typhoidal (Murphy), but scant consideration has been given the subject by American writers. As long ago as 1835, Maisonneuve<sup>1</sup> recognized osteomyelitis as a complication of typhoid. In 1876, Keen<sup>2</sup> from an analysis of thirty-seven cases decided that a definite connection existed between the attack of typhoid and the subsequent bone affection, but it remained for Ebermaier,<sup>3</sup> in 1889, to isolate in pure culture the typhoid bacillus and thereby establish definitely the dependence of the bone manifestations upon the initial disease. Whilst the bone distempers consecutive to typhoid fever are most commonly due to the typhoid bacillus, the abscess may be the seat of a mixed infection, or it may contain the pus cocci or it may be sterile. Of the fifty-one cases of inflammatory bone disease presumably of typhoidal origin collected by Keen in a second paper<sup>4</sup> published in 1898, thirteen grew the ordinary pyogenic cocci and thirty-eight the typhoid bacillus alone or in combination with other bacteria. Ebermaier was the first to call attention to the typhoid bacillus soon leaving the blood-stream and seeking refuge in the bone-marrow. From the marrow of a piece of rib secured at the autopsy upon a man who had died of intestinal hemorrhage he grew in culture media a few colonies of this microbe. A striking peculiarity of this habit, however, is the lack of development of manifest focal disturbances. Unless it becomes activated the host is oblivious of being a carrier. Why these bacilli, after varying periods of latency, are suddenly aroused into pernicious activity, no one has as yet satisfactorily explained. Keen believes muscle strain is a sufficient provocation to arouse their malevolent tendencies; Bondet<sup>5</sup> attributes it to slight traumata incurred by the use of the ice baths, and Fogh,<sup>6</sup> amongst others, to a blow. LeFilliatre<sup>7</sup> has seen it follow fatigue. Mouisset<sup>8</sup> mentions it as having occurred at the site of an old fracture, and Finlayson<sup>9</sup> in the scar of a tubercular lesion.

While typhoidal osteomyelitis may occur during the fever or in unusual instances after the lapse of years, the period of defervescence is the commonest time. Bunts<sup>10</sup> reports the recovery of a pure culture of typhoid from a tibial abscess, seventeen years after the appearance of the attack. Fogh<sup>6</sup> mentions their existence for twenty-three years in the femur; Tubby and Hicks,<sup>11</sup> for thirteen years in the ulna; Gore,<sup>12</sup> for eleven years in the frontal bone, and a number of observers for periods ranging from a year upwards. More mysti-

---

\* Read before the Southern Surgical Association, at Memphis, Tenn., December 12, 1922.

lying, however, are those cases with open sinuses for months and years which yield a pure culture of the typhoid bacillus. According to the modern concepts of bacteriology when drainage exists the original typhoid infection should be crowded out by the pyogenic cocci; yet Sultan<sup>13</sup> reports a case in which a pure culture of the bacillus typhosus was obtained from an open sinus of six years standing, and Parsons<sup>14</sup> a case from the pus of which at operation the typhoid bacillus alone was grown, but from the resulting sinus, six weeks later the *B. typhoideus* associated with the staphylococcus pyogenes aureus.

As long as a person shelters a single bacillus, he is a menace not only to himself but also to the community. The supposition is that from time to time bacterial emboli are swept into the blood-stream to find lodgment at other points or to be filtered out by the kidney and passed in the urine. To this behavior is attributed the successive metastatic bone explosions. Bigelow,<sup>15</sup> has reported an instance of a typhoidal sinus acting as a source of infection to others. Fruit handled by the patient served as the intermediate agent. The intensity of the primary attack does not have any particular influence on the severity of the bone lesion. A mild case may be followed by a very acute osteomyelitis and vice versa.

The disease is scarcely ever acute; almost always chronic. Although only one bone is usually involved, it is not uncommon for more than one bone to be attacked either simultaneously or successively. Frequently there are several consecutive periods of activity succeeded by symptomless intervals, after any of which resolution or suppuration may occur. As a rule constitutional symptoms, if any, are trivial. Fever is generally absent, but occasionally there is a moderate rise in temperature. The initial symptom is pain followed by tenderness and swelling in one or more bones. At first the pain is vaguely seated and fleeting, but it soon localizes and becomes lancinating and is more acute at night than during the day. The least pressure exacerbates it. Not until some days after the onset of the pain does tumefaction appear. The lump develops slowly and is usually limited to a small area. In a few cases the pain is the sole symptom of the bone involvement. Even after weeks or occasionally years of freedom from symptoms the pain and swelling may reappear at the same or another site and abscess form. More than one such oscillation may occur, followed by complete cure or suppuration. The skin at first is healthy. Only later does it become thin, violaceous and fixed. If abscess occurs, fluctuation may be detected. Local heat is but rarely present. The leucocyte count is usually within normal limits, but a leucocytosis of 15,000 to 20,000 has been observed with a polymorphonuclear ratio up to 89 per cent. According to Matthes, a persistent bradycardia in inflammatory bone disease is indicative of a typhoidal infection. The presence of this sign in an arthritis suggested to him the possibility of its typhoidal origin. The correctness of the impression was confirmed by bacteriological studies made after the death of the patient, who had had typhoid fever fifteen years previously. Any or all of the bony constituents



may be involved, thus has arisen the various terms used in describing the malady, *viz.*, periostitis, osteo-periostitis; osteomyelitis, bone abscess, etc. A periostitis may terminate by the formation of exostoses. The tibia, femur and ribs in the order named, are the bones most often attacked, but no bone is immune.

This affection has been mistaken for luetic, tubercular, sarcomatous and the common pyogenic bone diseases. Syphilitic involvement of the long bones, the tibia and femur excepted, is unusual. Lues is preëminently a disease of the flat bones. When the long bones are affected there is a marked tendency to bowing. Its symptoms are less acute; the osteoscopic pain more pronounced and suppuration more infrequent than those consecutive to typhoid. A positive Wassermann test, a characteristic luetic skiagraph, a history of a syphilitic taint and a benignant anti-luetic treatment are most helpful in cases of doubt. Tuberculosis preëmpts the epiphysis. Seldom, if ever, does it involve the shaft primarily. Pyococcic osteomyelitis occurs at the same age as the bone lesions consecutive to typhoid and like the latter by preference attacks the tibia; but typhoid osteitis is always preceded by enteric fever, its evolution is not so rapid, its fever as high, the leucocytosis as marked or the pain and tenderness as intense. Sarcoma announces itself by tumor formation evident to both sight and touch, as well as by the distinctive radiograph.

The disease usually runs a benign course. Either the plastic or the suppurative type may subside spontaneously. There is a marked tendency, however to chronicity. Amongst others, Klemm,<sup>16, 17, 18, 19</sup> Würtz,<sup>20</sup> and Urbantschitsch<sup>21</sup> have reported fatalities.

Prevention is rather to be desired than cure. Patients recovering from typhoid fever should be warned against injury to the osseous system and fatigue. For pain, repose in bed, friction and hot compresses have been used with success. The question of surgical intervention is largely a matter of judgment. Some cases resolve spontaneously; others are cured by simple incision and drainage and still others require repeated operations before the disease is finally brought under control. Especially is this true of incomplete operations upon the costal cartilages. As a rule the entire cartilage must be excised to obtain a permanent cure. Insufficient operations lead to sinus formation which may persist for years before finally closing. Whenever operation is undertaken, the medullary canal should be opened, otherwise hidden pockets of pus and sequestra containing cavities may be overlooked, thereby subjecting the patient to an ineffective ordeal. Most surgeons have thought it necessary to drain these wounds, but Unger,<sup>22</sup> Dupraz,<sup>23</sup> and Lilienthal,<sup>24, 25</sup> closed their incisions and obtained healing by first intention.

The status of vaccine treatment is still unsettled. Some observers have reported remarkable results. Sharpless,<sup>26</sup> Rosenberger,<sup>27</sup> Emile-Weil,<sup>28</sup> Sicard and Robineau,<sup>29</sup> and Dachtler,<sup>30</sup> have conclusively shown that under the influence of vaccines typhoidal osteomyelitis can be cured with the great-

est rapidity. Emile-Weil<sup>28</sup> has treated eighteen cases with stock solutions of triple vaccine, two of which were consecutive to paratyphoid B. An account of these cases has been incorporated by Chéron (Thèse, Paris, 1921) into his inaugural thesis. The reports of five of these cases were published in the early part of 1917, with the following results: Cure in three weeks of a suppurative typhoidal fistula of two years duration after seven operations had proven futile; cure in one week of a patient suffering for eleven months after three unsuccessful operations; amelioration in two cases after fifteen days of treatment; failure in a single instance only. Later in 1917, in conjunction with Chevrier he records seven additional cases. Two non-suppurative cases treated with vaccines alone had remained completely cured more than six months. Of the suppurative, one was cured, two improved and two unsuccessful. The injection may be made into the lesion or at a distance. Sicard recommends sixteen injections at two day intervals. Sharpless injected first 90,000,000 dead bacilli, followed at ten day intervals by 180,000,000. Rosenberger closed a fistula after seven injections of an autogenous vaccine.

The purpose of this paper is to call attention to osteomyelitis as a relic of typhoid fever; to tabulate the cases in which the B. typhosus has been found and in particular to place on record two additional cases.

*Case Reports.* CASE I.—A white female, aged twenty-four, entered the University Hospital, Baltimore, October 11, 1921, for a soreness in the right thigh. Two years ago last August, she had had a typhoid fever of 8 weeks' duration. Her convalescence was uneventful until 8 weeks after defervescence when she was suddenly seized with a lancinating pain in the lower part of the right thigh. After a few days this ceased as suddenly as it appeared. In January, 1921, she was delivered instrumentally of a full term but dead infant. The death was attributed by the physician in attendance to the length of the labor, not to a constitutional diathesis. No ill results followed the confinement and the patient was about her household duties in the usual time. Three months later while apparently enjoying the best of health, she experienced, without warning, a repetition of the pain. Like the first attack, this gradually subsided. Since the initial attack there have been five distinct recrudescences of the complaint, similar in all respects to the first but less severe.

The present attack began 6 weeks ago. Three days after its inception she had a chill. Her condition gradually became worse and two weeks ago she had to go to bed. Even with the leg at rest the pain did not subside and she sought the hospital for relief. Upon examination the affected leg looked normal; the skin was natural in appearance and the soft tissues not noticeably swollen. Deep pressure over the middle and inner aspect of the femur caused intense suffering. At this point the right thigh measured 16½ inches, the left 15¾. The femur itself appeared thickened. The knee could be flexed voluntarily, but the act was very painful. By October 18th, the local symptoms had all become accentuated and fluctuation was definitely determined. The temperature had ranged since admission between 99° and 101° F. No history of traumatism could be elicited. The blood Wassermann was negative; the Widal negative; the leucocytes 20,000 with a ratio of 89 per cent. polymorphonuclears, 10 per cent. small mononuclears, and 1 per cent. large mononuclears. The radiographer reported thickening and roughening of the periosteum along the middle third of the shaft of the femur suggesting an osteomyelitis. Despite the high leucocytosis and the negative

Widal, the history of a preceding typhoid followed by numerous attacks of pain in the bone with periods of activity and quiescence led to a diagnosis of post-typhoid osteomyelitis for the relief of which an operation was advised.

On October 19, 1921, with the patient under ether, Dr. A. M. Shipley, incised the abscess and a quart of yellowish-green, odorless pus escaped. The femur lay freely exposed in the abscess cavity. The periosteal covering of this bone had been completely destroyed. Several small sequestra were seen protruding from it. These were removed. A hole was bored into the medullary canal and a considerable amount of flaky pus set free. A second trephining was made about two inches above the first and rubber tubes were inserted for Dakinizing purposes. The abscess cavity was packed with plain gauze. September 1, 1922, the patient reported the wound was still discharging. Cultures made from the pus obtained at the operation grew the typhoid bacillus alone.†

CASE II.—A white man, aged seventy, entered the University Hospital, February 3, 1921, for relief from a discharging sinus in the lower and front part of the right side of the chest. He had had an uncomplicated attack of typhoid fever in the summer of 1920. The first intimation of anything wrong was during convalescence when he noticed a tenderness at the site indicated. The discomfort instead of improving gradually increased; the skin became red and glistening; an abscess finally formed and broke open. On admission there was seen over the 8th costal cartilage near the sternal margin a sinus from which pus exuded. The temperature was 98; pulse 60; respiration 20. An X-ray examination did not reveal necrosis of either the rib or cartilage. The clinical impression was post-typhoid perichondritis. Operation, February 3, 1921, by Doctor Shipley. As the man's condition did not warrant a general anaesthetic, the operation was done under local anaesthesia (0.5 procaine solution). The sinus was freely opened down to the cartilage of the 8th rib which was found to be the seat of a suppurative perichondritis. The diseased portion of the cartilage was excised; the soft tissues thoroughly curetted and three Carrel tubes inserted. The sinus persisted, however, until July 28, 1922, when it closed spontaneously, never to reopen. In this case no cultures were made until 9 months after the operation. Despite the existence of a sinus during all this time, the culture yielded the *B. typhosus* alone.

A third case, undoubtedly typhoidal in origin, came under my care during the same period. The patient, a white female, had had a typical attack of typhoid fever two years previously from which she made an uncomplicated recovery and was well for a year and a half subsequently, when her attention was directed to a painful lump over the 6th left costal cartilage near the sternal end. Gradually but progressively the mass increased until it had reached the size of a hen's egg. It was round, tense, non-fluctuating and apparently fixed at its base to the rib cartilage, but not very sensitive to touch. The overlying skin was bulging, but not inflamed. The woman's general health was unimpaired. Though the patient was told that the mass was probably a typhoidal chondritis, she feared cancer and demanded its removal. So on June 5, 1921, under ether anaesthesia, an incision was made into the mass permitting the escape of a few drops of a thick, odorless, sticky, creamy pus. The entire cartilage together with a portion of the adjoining rib and sternum was excised and the wound closed with the exception of a small aperture for the emergence of a gauze wick. A rapid cure resulted and the patient reported October 10, 1922, she had had no further recurrence of the trouble. Cultures were not made because the operation was done in the patient's home.

---

† A recent note from the patient states that the wound has closed and she is entirely well.

## NATHAN WINSLOW

In my search of the literature, I could find only 101 cases of bacteriologically proven osteomyelitis due entirely or in part to the *B. typhosus*. An analysis of their salient features gives the following information:

Sex: Males 65: Females 29: Not given 7.

Age, number in each decade

1-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	Man	Boy	Girl	Not given
4	20	26	16	12	1	2	1	8	2	1	8

The youngest patient was 2 years old, the oldest 70. Twenty-four were under 20; 50 under 30 and 32 over 30; the remainder were merely described as man, boy, girl or not at all.

### Bacteriological findings

Bacillus typhosus alone .....	94
Bacillus typhosus and bacillus coli communis .....	2
Bacillus typhosus and staphylococcus pyogenes aureus .....	1
Bacillus typhosus and streptococcus pyogenes .....	2
Bacillus typhosus and staphylococcus pyogenes citreus .....	1
Bacillus typhosus and pneumococcus .....	1

### Number of bones attacked in each case

1 bone .....	68
2 bones .....	23
3 bones .....	2
4 bones .....	2
5 bones .....	4
6 bones .....	2

These figures show a total of 160 bone lesions in the 101 patients.

### Bone attacked and number of times

Tibia .....	56
Femur .....	27
Ribs and costal cartilages .....	27
Ulna .....	9
Radius .....	7
Mastoid .....	6
Sternum .....	4
Metacarpal .....	4
Clavicle .....	4
Humerus .....	3
Metatarsal .....	3
Parietal .....	3
Phalanx (hand) .....	2
Temporal .....	1
Ilium .....	1
Frontal .....	1
Pubic .....	1
Fibula .....	1

## TYPHOIDAL OSTEOMYELITIS

### Metastasis to the costal cartilages

Under 20 .....	1
20-30 .....	5
30-40 .....	6
40-50 .....	9
50-60 .....	0
60-70 .....	1
70-80 .....	1
Young man .....	1
Not given .....	3

While infection of the skeletal system in general shows a predilection for people under 30, that of the costal cartilages occurs more frequently at a later period, namely 6 below and 17 over 30.

The time of onset of the bone manifestation was:

During attack .....	9
First two weeks of convalescence .....	11
2nd to 6th week of convalescence .....	8
During convalescence (time not specified) .....	53
Months or years after convalescence .....	20

The lesions varied from small superficial areas of caries to extensive destruction of the bone.

### Progress

Died	Cured	Healing	Bone still enlarged	Persisting sinus	Not stated
9	48	8	1	10	25

Four patients required 2 operations before cured and one submitted to 3 operations.

Eighteen were of the acute type; 83 chronic.

When sequestra were met with, they were described as small and were rarely over an inch long.

Seldom was the diagnosis made or even suspected before the bacteriology of the pus was investigated.

I did not find a single example of vertebral abscess substantiated by bacteriological examination. Raymond and Sicard<sup>31</sup> mention having performed a laminectomy for an extradural lumbar abscess, but take pains to specify that the bone was not diseased. Guyot<sup>32</sup> attributed a lumbar abscess to the ravages of typhoid but said the patient did not present anything abnormal in the backbone, nor did he make any bacteriological study of the pus.

Seven cases were reported as having followed an injury and one at the site of an old fracture.

Bigelow tells us of 3 people having been infected with typhoid by a man with a sternal sinus.

It is indeed remarkable, a disease as relatively common, as crippling, as stubborn to treatment as typhoid osteomyelitis has received so little attention.

### CONCLUSIONS

1. Persistent bone pain with the history of a previous typhoid fever should suggest the possibility of a typhoidal osteomyelitis.
2. In suppurative bone disease a careful investigation of the bacteriology of the pus is necessary for an accurate diagnosis.

3. When suppuration occurs surgery offers the patient the surest and quickest road to complete cure.
4. Vaccino-therapy has been used with success in a few cases, both suppurative and nonsuppurative, with and without operation.

# BIBLIOGRAPHY

- <sup>1</sup> Maisonneuve: Thèse d'agrégation, Paris, 1835.
- <sup>2</sup> Keen: Surg. Complications and Sequels of Typhoid Fever, 1898.
- <sup>3</sup> Ebermaier: Deut. Arch. f. klin. Med., 1888-1889, vol. xlv, p. 141.
- <sup>4</sup> Keen: Toner Lecture, Smithsonian Institution, Washington. On the Surgical Complications and Sequels of Continued Fevers, 1877.
- <sup>5</sup> Bondet: Bull. de l'Acad. de méd., 1883, 2. s., vol. xii, p. 217.
- <sup>6</sup> Fogh: Deut. med. Woch., 1908, vol. xxxiv, p. 1305.
- <sup>7</sup> Le Filliatre: Jour. de méd. et de chir. prat., 1898, vol. lxii, p. 871.
- <sup>8</sup> Mouisset: Lyon médicale, 1891, vol. lxvii, p. 326.
- <sup>9</sup> Finlayson: Amer. Jour. of the Med. Sci., 1891, n. s., vol. ci, p. 229.
- <sup>10</sup> Bunts: Trans. Amer. Surg. Assn., 1915, vol. xxxiii, p. 694.
- <sup>11</sup> Tubby and Hicks: Lancet, Lond., 1913, vol. i, p. 304.
- <sup>12</sup> Gore: Proc. Roy. Soc. of Med., Lond., 1912, vol. v, sect. surg., p. 1.
- <sup>13</sup> Sultan: Deut. med. Woch., 1894, vol. xx, p. 675.
- <sup>14</sup> Parsons: Johns Hopkins Hosp. Repts., 1895, vol. v, p. 418.
- <sup>15</sup> Bigelow: Jour. Amer. Med. Assn., 1912, vol. lviii, p. 1339.
- <sup>16</sup> Klemm: Arch. f. klin. Chir., 1912, vol. xcix, p. 424.
- <sup>17</sup> Klemm: Arch. f. klin. Chir., Berl., 1893, vol. xlv, p. 862.
- <sup>18</sup> Klemm: Arch. f. klin. Chir., 1894, vol. xlviii, p. 793.
- <sup>19</sup> Klemm: Beitr. z. klin. Chir., 1913, vol. lxxxiv, p. 369.
- <sup>20</sup> Würtz: Jahrbuch f. Kinderheilk., 1899, vol. xlix, p. 12.
- <sup>21</sup> Urbantschitsch, E.: Monatsft. f. Ohrenhilk., Berl., 1916, vol. i, pp. 1-57.
- <sup>22</sup> Unger: Deut. med. Woch., 1901, vol. xxvii, p. 522.
- <sup>23</sup> Dupraz: Arch. de méd. expérimentale et d'Anat. path., 1892, vol. iv, p. 76.
- <sup>24</sup> Lilienthal: Intern. Jour. Surg., 1907, vol. xx, p. 71.
- <sup>25</sup> Lilienthal: Amer. Med., 1911, n. s. vol. vi, complete ser., vol. xvii, p. 143.
- <sup>26</sup> Sharpless: Jour. Amer. Med. Assn., 1912, vol. lviii, p. 1114.
- <sup>27</sup> Rosenberger: New York Med. Jour., 1911, vol. xciii, p. 927.
- <sup>28</sup> Emile-Weil: Bull. et mém. d. l. Soc. méd. d. hôp. d. Paris, 1921, 3. s., vol. xlv, p. 449.
- <sup>29</sup> Sicard et Robineau: Bull. et mém. d. l. Soc. méd. d. hôp. d. Paris, 1921, 3. s., vol. xlv, p. 465.
- <sup>30</sup> Dachtler: Amer. Jour. Roentg., Detroit, 1913-1914, n. s., vol. i, p. 252.
- <sup>31</sup> Raymond et Sicard: Bull. et mém. d. l. Soc. méd. d. hôp. d. Paris, 1905, 3. s., vol. xxii, p. 860.
- <sup>32</sup> Guyot: Gaz. hebdom. d. sci. méd. de Bordeaux, 1906, vol. xxvii, p. 9.

## RADICAL OPERATION FOR CHRONIC EMPYEMA\*

BY CARL EGGERS, M.D.

OF NEW YORK

IN a recent article on chronic empyema † I have enumerated the various causes, both predisposing and real, which lead to chronicity. In the same paper I have dealt with the question of conservative treatment and with the treatment of superficial post-empyemic fistulæ.

This paper deals with the treatment of deep sinuses and cavities which have resisted such conservative measures, and it is therefore to be looked upon as a continuation of the above-mentioned article.

It is my belief that the majority of patients suffering from chronic empyema will get well by the establishment of good drainage, aided by artificial sterilization of the cavity and attention to their general condition and hygiene. But in spite of these measures some patients refuse to heal. This applies not alone to those in whom it was impossible to sterilize the cavity, but also to those in whom superficial sterility had been obtained by the use of Dakin solution. I say superficial or surface sterility because none of the solutions used for irrigation are able to produce sterility of the deeper layers of the lining of a chronic empyema cavity. This is one of the reasons for non-healing and recurrence. Other reasons are found in the mechanics of the thorax, such as a rigid thoracic wall, a collapsed lung, a firm, unyielding pleura, pockets and recesses in connection with the empyema cavity, which are inaccessible to treatment, bronchial communications and tuberculosis.

The operative procedures necessary to bring these patients to a complete cure consist of more than simple drainage and irrigation. It is necessary to remove the obstacles to healing, be they an infected lining of the cavity, an unyielding pleura, narrow recesses, a rigid thoracic wall, a bronchial communication or tuberculosis. Not the same methods of treatment are indicated in all cases, nor is it always necessary to sacrifice a large number of ribs. The term radical operation is here used to indicate an attempt at the radical removal of the causes of non-healing, not as an attempt to produce complete collapse of the chest wall.

This paper deals with 146 cases on which I have operated to date. The group includes cases from army and civil practice. Most of them had drained for from six months to two years, the longest twelve years. Nearly all patients had been under the care of a number of surgeons, and different forms of treatment had been tried. Most of them had been continuously on Dakin-Carrel treatment, some had had one or more radical operations and a few

---

\* Read before the New York Surgical Society, November 8, 1922.

† Chronic Empyema. Its Etiology, Pathology, Diagnosis, Complications, Treatment and Final Results. By Carl Eggers, M.D., New York. ANNALS OF SURGERY, February, 1923.

were quite mutilated. They were very rebellious cases that showed no tendency to heal, whether the cavity was sterile or not. The decision to operate was based not alone on the length of time a patient had drained, but rather on the local condition found. It has been our aim to diagnose the condition as nearly as possible, and then institute that operative procedure calculated to cure it. For this reason all patients were subjected to thorough physical examination, laboratory study and examination with the X-ray, both without and with bismuth injection of the cavity. In this way it was possible to place them into one or the other of the groups described below. One should never attempt a radical operation with the idea of dealing with conditions as they are found during operation, but instead study the case carefully in advance and then plan the operation according to indications. To do the operation speedily, and with as little shock as possible, one should plan big and then go ahead and do it, not resect a rib or two, putter around and finally decide to resect another.

The element of time alone is not sufficient to determine whether a radical operation is indicated, for even very old cases may sometimes be healed by the establishment of good drainage aided by Dakin-Carrel treatment. However, if after the establishment of good drainage, a patient shows no tendency to heal, long after the time that it usually takes empyema patients to heal, and one recognizes faulty local conditions that are not likely to yield to conservative measures, operation is indicated. Whether it should be done at that time depends on the general condition of the patient. If he is still anæmic and undernourished, one must wait, because any radical operation is apt to be connected with considerable shock. Conditions being favorable, the operation is advised.

Previous to operation all patients who had not been so treated were put on intensive Dakin-Carrel treatment, with the establishment of good drainage. The severity of the infection was controlled by frequent culture of the secretions. Two objects were followed, either to bring about healing by these means, or if that failed, to have the field clean for a radical operation.

With the exception of a few, in which there was a distinct contra-indication, all cases were operated on under general ether anæsthesia. No differential pressure apparatus is required because the lung either has been collapsed for a long time, and the patient has accommodated to it, or if the lung is compressed, extensive adhesions will prevent complete collapse after operation.

There are several main groups of cases.

1. Cases with an empyema cavity communicating with the surface by a narrow sinus.
2. Cases with a long irregular sinus, often reaching from the opening in the chest-wall to the apex of the thorax.
3. Cases with an ordinary chronic empyema cavity, the walls of which are so rigid that healing can not take place, or the walls of which are so infected that it is impossible to sterilize them.



4. Cases with a chronic empyema cavity that has communicating pockets or recesses which are not accessible to treatment.
5. Cases with a chronic pneumothorax.
6. Cases with bronchial communications.
7. Cases with tuberculosis.

*Group I.—Cases with an empyema cavity communicating with the outside by a narrow sinus.*

Reference is made to only those cases in which the drainage is considered dependent and adequate, and which have been on Dakin-Carrel treatment without attaining the desired result. This group comprises twenty cases. These are often patients in whom drainage was established too low. As healing progressed the costo-phrenic sinus became obliterated, the diaphragm approached the thoracic wall and a narrow sinus developed, with more or less valvular action. Pus collections in the mediastinum or in the upper thorax, finding their exit on the lateral thoracic wall, also belong in this class. The treatment consists in the radical extirpation of the entire fistula together with all surrounding tissue, until a large opening into the cavity is obtained. The incision is so placed as to surround the fistula, the muscles are pushed back and a portion of from two to four ribs is resected, depending on the case. Usually only short pieces, two to three inches in length, have to be sacrificed. The entire fistulous tract, with its surrounding skin, new-formed bone, and thickened pleura, is excised in one piece. All tissue which harbors infection and which has been the cause of re-infecting the cavity, is thus removed, and a large opening into the cavity obtained. The latter is then examined to determine that it is smooth and clean, and that no foreign body is present. After this Carrel tubes are inserted, together with a large outlet tube, and muscles and skin partly closed. Dakin-Carrel treatment is started at once and continued in the regulation manner until sterility of the cavity is obtained, when it is allowed to close. In this group of twenty cases there was no mortality. Several healed in four weeks, while others took somewhat longer, one continuing to drain for three months. All but four patients, about whom we have not been able to get information, have healed and remained well.

In suitable cases this method gives excellent results; it is not associated with shock and produces no deformity.

*Group II.—Cases with intractable deep sinuses.*

*Group III.—Cases with a rigid chronic empyema cavity having infected walls.*

*Group IV.—Cases with an empyema cavity having communicating pockets or recesses.*

The treatment of these three groups may be considered under one heading, because the principles underlying it are the same, though the details of the operation may vary. Whether one deals with a deep sinus or a cavity makes no difference, for the former simply represents a more advanced process. Healing has failed to take place owing to one factor or several existing at the

same time. The walls are so rigid that they are unable to meet, the lining may be infected in its deeper layers and lead to re-infection of the cavity, either immediately or after temporary healing, thus producing a recurrence. Narrow recesses harboring infection may communicate with the cavity and constantly lead to re-infection.

The object of the operation is to overcome or remove these various conditions. In order to do that it is necessary to mobilize the chest wall,

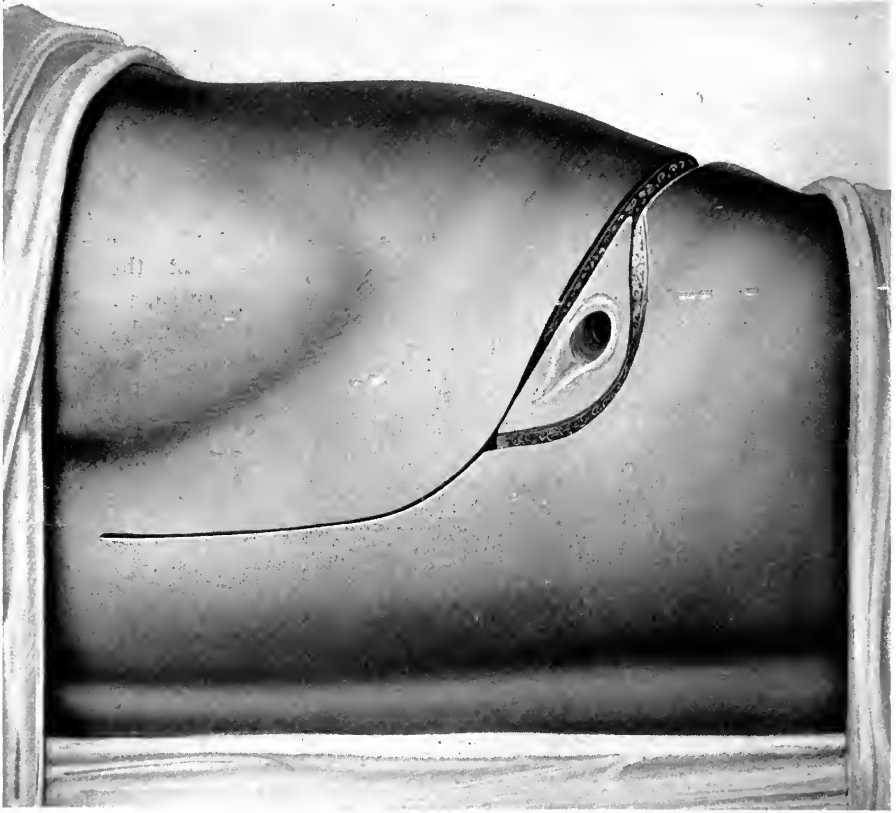


FIG. 1.—Line of incision in a typical case.

mobilize the lung, and completely remove all infected tissue lining the cavity. It has been, and is still, our belief that one should not depend on mobilization of the chest wall as the principal aid, but rather on the thorough mobilization of the lung to such a degree that it is again able to expand to the limits of the chest wall. The operation is planned and carried out with this object in view.

Most cavities and sinuses run up posteriorly, and in a typical case the incision is therefore so placed that its upper end will correspond with the upper end of the cavity. It is usually begun midway between the inner

## RADICAL OPERATION FOR CHRONIC EMPYEMA

border of the scapula and the spine, carried downward to encircle the fistulous opening and scar, and ends below and forward at the lowest limit of the cavity (Fig. 1). The muscles are then divided in a similar way and pushed upward, carrying along the scapula, so that the necessary portion of the bony chest wall is exposed (Fig. 2). By placing the patient as shown in Fig. 3, the arm of the affected side can be moved upward, carrying along the scapula, so that ample exposure is obtained. Portions of the

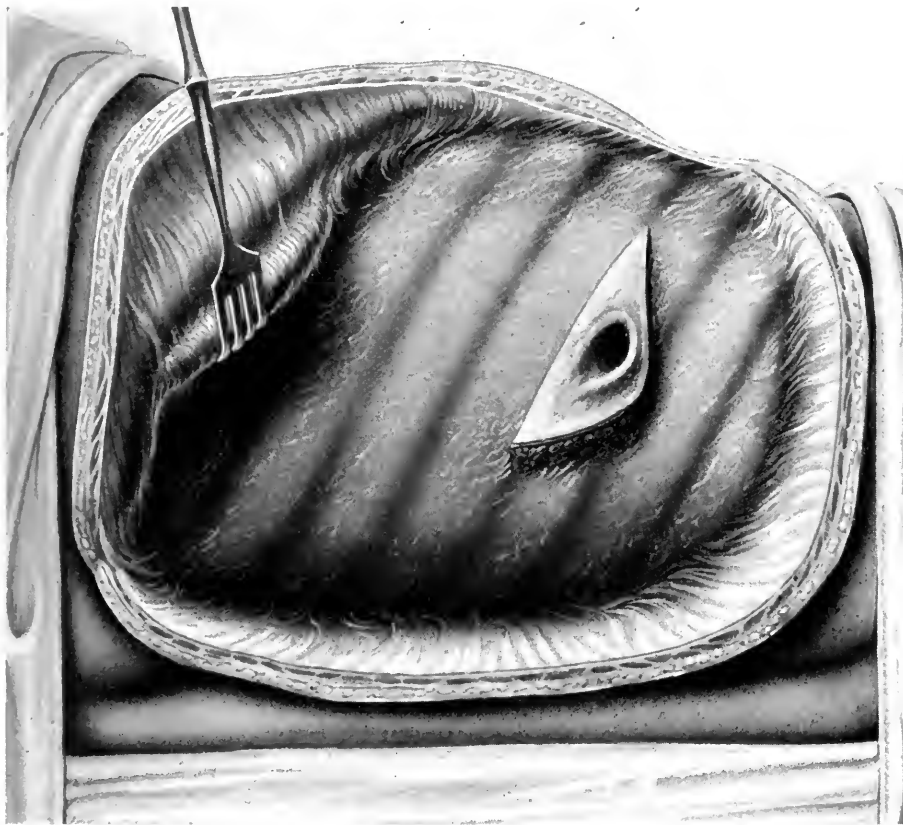


FIG. 2.—Muscles and skin pushed back exposing ribs.

ribs overlying the cavity are now removed in rapid succession. In these chronic cases this is never easy, and sometimes very difficult, especially in those patients in whom parts of several ribs have been removed during former operations. In these cases there is often fusion of several ribs and complete bony rings or even plates have formed. In addition to this the internal surface of that portion of the ribs overlying the cavity has often become very much thickened by periostitis, and this new-formed bone is firmly embedded in the wall of the cavity. The ribs instead of being flat are triangular in shape. To avoid spreading infection it is our object to remove the fused bone with inter-

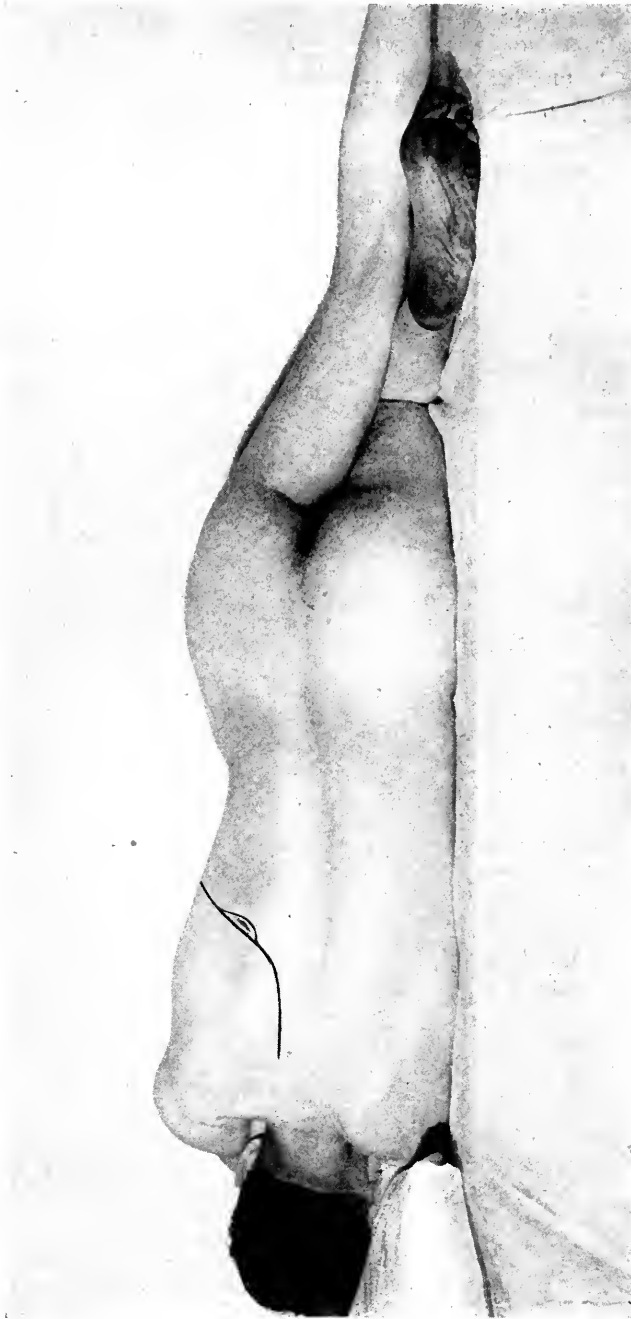


FIG. 3.—Position of patient which allows rolling him forward or backward.

vening infected tissue, and the fistula in one piece. Separating the ribs is made easier if one uses the periosteal elevator along their upper border from behind forward, and along their inferior border in the opposite direction.

In those patients who have previously had a more or less radical operation, it is found that the anterior ends of ribs are flat and easily separated, while the posterior ends are thick, nodular, and difficult to remove. It appears that growth of bone takes place principally in the posterior ends, probably because the nutrient artery enters that portion. As mentioned before, the object

of this operation is not to bring about collapse of the chest wall, but simply to mobilize it. For this reason it is necessary to remove but short pieces of rib. Because the intervening intercostal tissues may be the seat of

## RADICAL OPERATION FOR CHRONIC EMPYEMA

infection, and interfere with a thorough operation, they are also removed, after ligating them just beyond the bony ends. After removing the necessary bone and intercostal tissue the outer wall of the fistula or cavity is exposed, and it is now possible to split it upward to its upper limit (Fig. 4). This outer wall represents the parietal pleura. It is usually one-fourth to one-half inch thick, but occasionally reaches a thickness of three-quarters inch. It

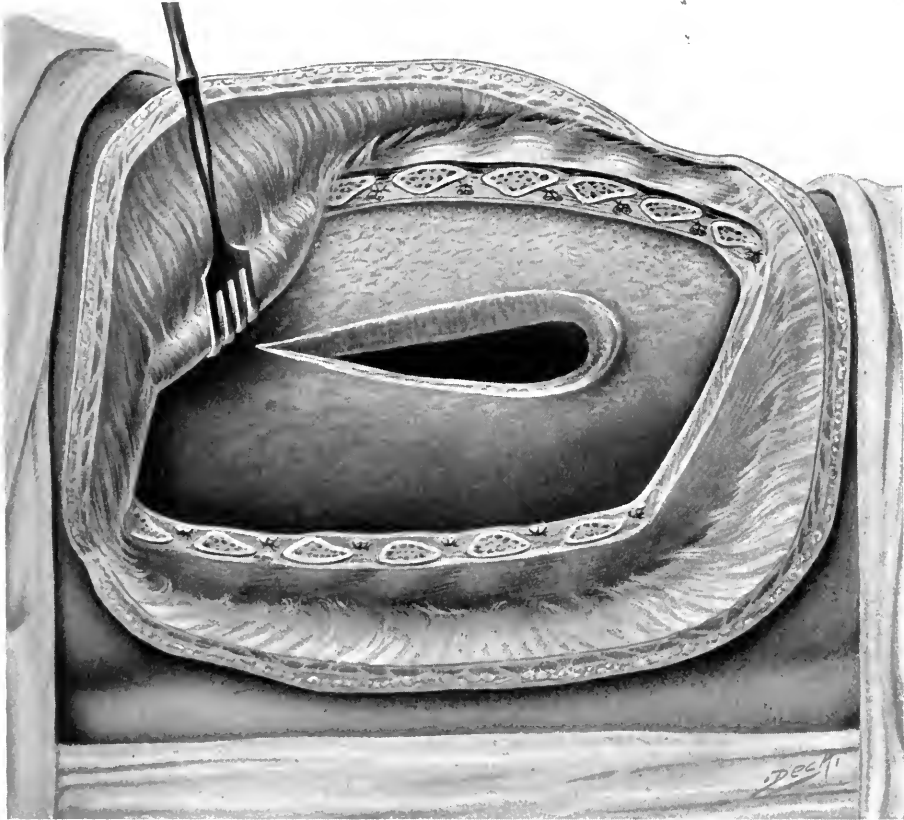


FIG. 4.—Outer wall of cavity exposed and split upward.

is firm and frequently cuts like cartilage. This wall is now removed in its entirety, exposing the floor of the cavity. The latter is dried and carefully inspected for recesses or pockets extending beyond the main cavity. Even with bismuth injections these recesses sometimes do not show up, and it is therefore important to be watchful during the entire course of the operation. A little area of pouting granulations may indicate the opening into one of these extensions. They may be found at any part of the cavity, extending upward, or towards the mediastinum. The most common ones are those extending from the lower part of the cavity into the costo-phrenic sinus, either forward or backward. They serve to explain why cavities never

become sterile or healed. The X-ray of patient B (Fig. 12), who had a chronic empyema for twelve years, shows bismuth in such small club-shaped cavity situated in the extreme anterior end of the costo-phrenic sinus. Part of the costal cartilages had to be removed to gain access to it. These

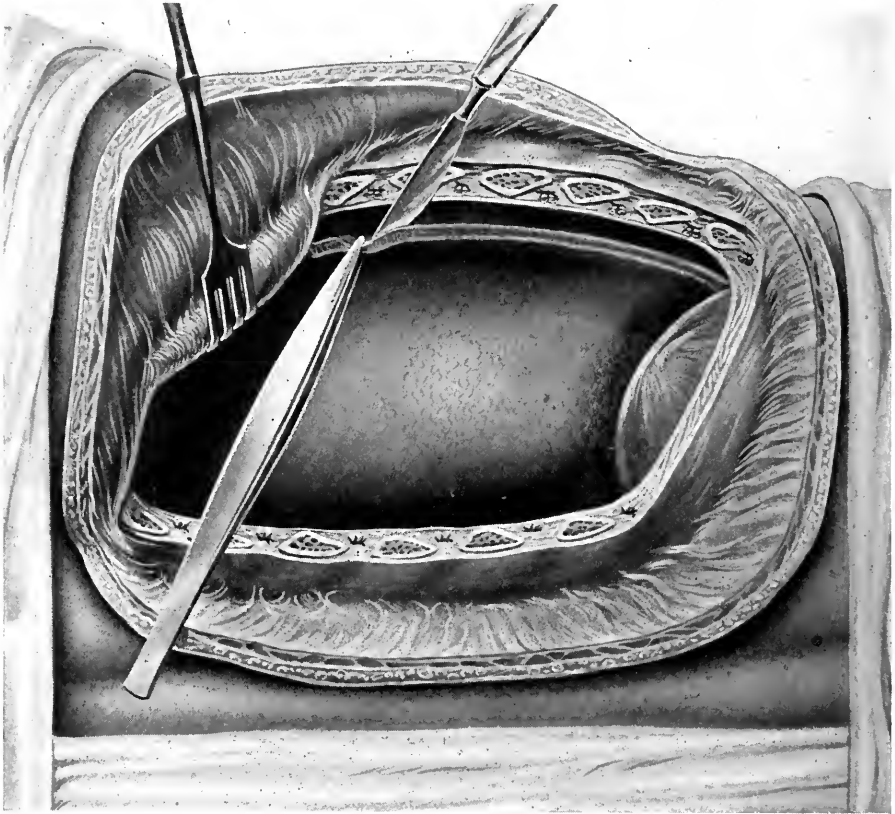


FIG. 5.—Outer wall removed. Dissection of angle of reflection of pleura being started.

recesses must be completely extirpated, because they harbor infection and lead to re-infection of cavities.

Inspection of the floor of the cavity may show absolute immobility, but usually respiratory movements are noticed in the central part, while there are none towards the margin, where the lung is fixed by dense connective tissue, holding it to the chest wall. The most important step in the operation, the removal of this dense tissue, is now begun (Fig. 5). Starting at the margin of the cavity, where we left off after removing the outer or parietal layer, the dissection is carried towards the lung. A mouse-toothed forceps and a sharp knife are the best instruments for this purpose. As soon as this incision has been carried around the margins of the cavity, and the lung is reached, increased mobility of the latter is noted. At this stage it is well to

## RADICAL OPERATION FOR CHRONIC EMPYEMA

remove the tissue so liberated, and then with increased caution proceed to decorticate the lung itself. In some cases this is easy, and one may even bluntly shell off the inflammatory layer covering the lung. In other cases it is extremely difficult, and one succeeds in removing only narrow strips near the margin, while in the central portion the covering is so thin that there is nothing to strip off. It is my belief, that although one speaks of

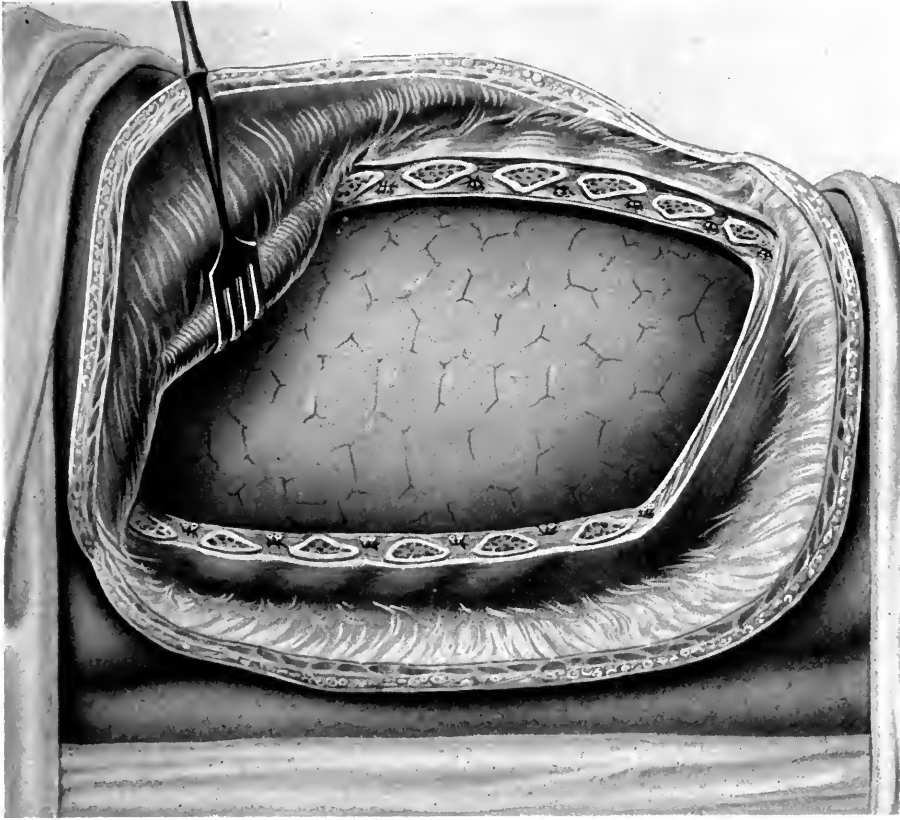


FIG. 6.—Lung completely decorticated and expanded. Wound ready for closure.

removing the visceral pleura, the tissue that is actually removed is not visceral pleura, but a layer of inflammatory tissue covering it, leaving the pleura itself more or less intact. In some patients, however, visceral pleura and inflammatory layer are so closely incorporated as to make their removal impossible. Under these circumstances criss-cross incisions as recommended by Ransohoff are resorted to. As soon as made, these incisions promptly spread, thus allowing expansion of the lung. With the finger one may now bluntly separate the lung a little more from the chest wall and diaphragm, and it is surprising how beautifully it often expands, though it may have been compressed for years. At this stage of the operation we allow the

anæsthesia to become more superficial and we encourage the patient to strain by inserting a spatula into the back part of his throat. During these straining efforts a lung which looks dark owing to poor aëration from compression will expand and become pink in color. Sometimes it even becomes necessary to hold it down with hot pads because it tends to expand beyond the limits of the chest wall. These are very favorable cases, and one depends on this



FIG. 7.—Wound being closed, drainage established at lowest part of cavity.

reëxpansion chiefly to bring about obliteration of the cavity. In other cases, owing to fibrous changes that have taken place in the lung tissue, expansion is poor, even though the lung is completely mobilized. These are less favorable cases, and one has to depend chiefly on the mobilization of the chest wall to bring about healing. Having removed all inflammatory tissue, including recesses, one finds a clean diaphragm, and a clean lung, and after drying out the wound, one is ready for closure (Fig. 6). The more accurately the dissection has been carried out, and with the least damage to vital structures, the better the result.



Closure of the wound is effected by approximating the muscles with interrupted chromic gut sutures, and then closing the skin with silkworm gut. One or two short drainage tubes are inserted at the dependent part of the cavity. As the latter frequently extends somewhat below the line of incision, a short vertical incision is added and the drainage tubes brought out through this opening (Fig. 7). A dry dressing is applied, held in place by means of a binder. In case the scapular muscles have been divided, a second binder is applied, which holds the arm to the side of the body. So-called pneumonia jackets are excellent for this purpose.

The immediate after-treatment consists in the administration of a hot coffee enema of six ounces containing half an ounce of whisky and one-fifteenth grain of strychnine. Stimulation and hypodermoclysis are ordered if indicated. Hypodermoclysis should be given under the skin of the inner side of the thighs so as not to interfere with respiration. Morphine is given freely during the first few days.

There is usually considerable serous or sero-sanguineous discharge during the first few days, which, however, quickly subsides if the wound remains sterile. The further treatment depends on the course. If the discharge is sterile, and remains so, we remove the drainage tube in a few days and obtain early closure of the wound. Such cases are illustrated by patient T (Fig. 8). If organisms are present in the discharge, and it is turbid, we give one Dakin irrigation every morning, not beginning before a week has passed, however, to prevent fluid and possibly infection being carried into the deeper parts of the wound. If real pus develops, as is more likely the case in those patients, in whom an incomplete decortication was done, regular Dakin-Carrel treatment is instituted.

All patients are encouraged to sit up early, to breathe deeply, and to get out of bed in from three to seven days. The use of blow-bottles is begun early, to maintain the regular aëration of the lungs which was begun on the operating table. Sutures are removed on the seventh day, and as soon as the wound is firm, light arm exercises are carried out in addition to deep breathing.

I have treated 99 cases by the method just described. Some were comparatively easy, while others were extremely difficult. When it is realized that chronic empyema is a disease in which conditions vary a great deal, it becomes evident that the operation has to be varied to meet these conditions. Some patients have several drainage openings, a low one, a high one, and perhaps another one in front. Still others have extensive fusion of ribs, or one finds a wide open thorax, the result of former radical operations. Instead of the typical cavity situated low, and extending up posteriorly, we had quite a number of patients with a cavity in the upper thorax, or with an extension toward the mediastinum. In some patients, especially those with a small cavity and good muscular development, we have turned the edges of the muscles into the cavity to aid in obliterating it. In seven patients we found a foreign body, rubber tubing in four, and in one each

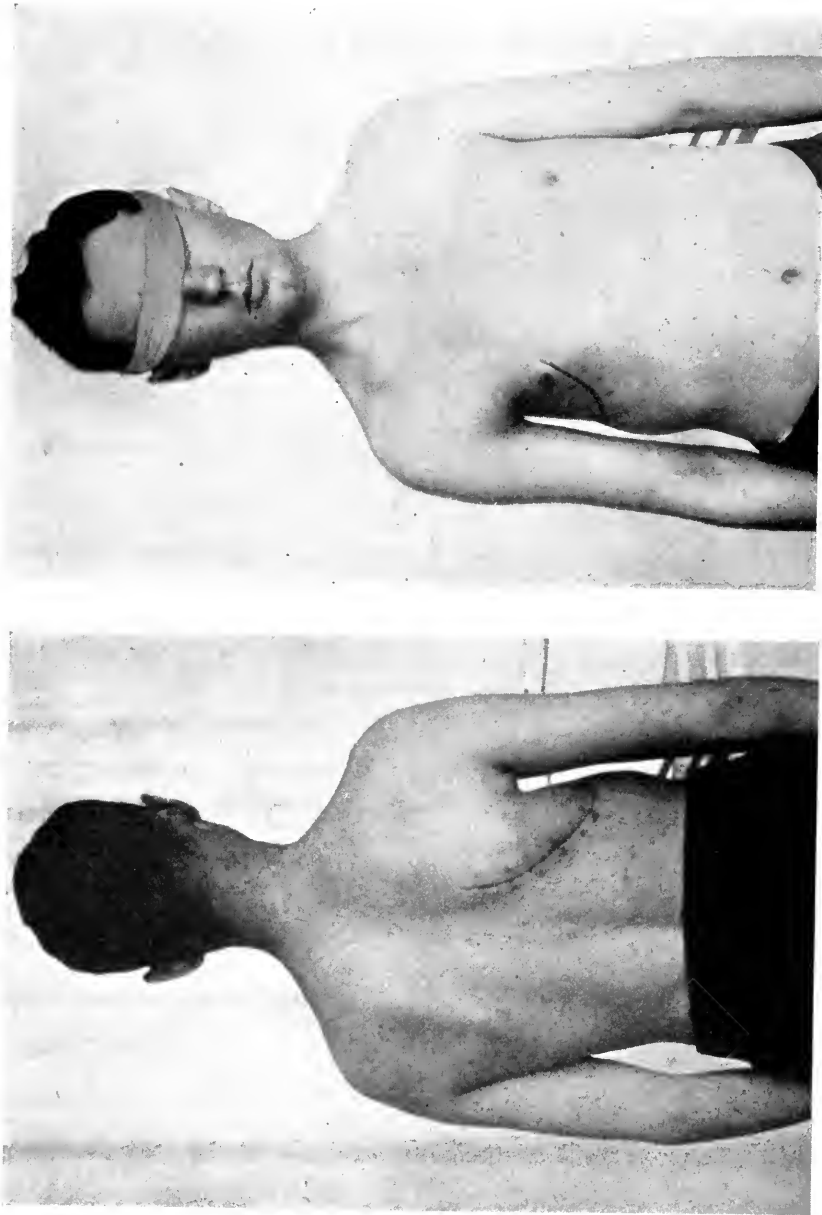


FIG. 8.—Patient H. T. Radical operation, June 11, 1910. Resection of portions of 9th, 8th, 7th, 6th, 5th and 4th ribs. Complete decortication. Wound firmly healed, July 5, 1910.

a bullet, a shell fragment and a piece of uniform. In spite of these findings, however, a radical operation was done because other factors, such as a rigid wall, or recesses, coëxisted and would probably have prevented healing. In some patients only an incomplete decortication was done, owing to their poor condition or to technical difficulties. Sometimes one has to be satisfied with an incomplete operation, a great deal has been gained, and by treating the patient conservatively, healing may be obtained. If necessary one may later re-operate and then find conditions more favorable. It not infrequently becomes necessary to divide the operation into several stages, to avoid the danger of shock. At the first operation one may simply remove the necessary portions of ribs, which in itself is often the most difficult part of the operation on account of fusion of bone and hemorrhage while resecting this bone. At the second operation one may do the complete decortication, or if several recesses are present, one may again subdivide this and do only one recess at a time. If an unusual amount of bleeding is encountered, one may pack the wound, leave the packing in place, and not disturb it until the second operation a week or ten days later. The periods between the different stages of the operation may vary from a week to several months, depending on the condition of the patient. One must not be hurried into an ill-timed operation.

Of the 99 cases here reported, 41 healed in from four to eight weeks; others took longer, and a few had to be subsequently operated on either by myself or someone else. This applies especially to some army cases, which I had to leave soon after I had operated on them. All my patients in civil practice I have been able to follow to a successful result. The two group pictures (Fig. 9 and Fig. 10) represent typical cases of this type.

Of the total number, 67 are known to be healed, 12 are known not to be healed, 1 died, 19 have not been heard from. The latter group are all army cases. For one reason or another it has not been possible to get in touch with these men. It is assumed, however, that the great majority of them are healed, for notes made at the time of operation and soon after, indicate that conditions for healing were favorable. Among these 99 cases there was a mortality of one.

Case Report.—A civilian male patient, fifty-four years old. He had a chronic empyema for two years which had been healed for a while, but re-opened. On account of a mitral regurgitation and a chronic nephritis, he was operated on under local anæsthesia. Portions of 2 ribs were removed, the cavity cleaned out, and Dakin-Carrel treatment then started. Because there was no diminution in the size of the cavity he was re-operated five weeks later. Rectal ether anæsthesia in conjunction with the hypodermic administration of 300 c.c. of a 4 per cent. magn. sulphate solution were given. A portion of an additional rib was resected and decortication attempted, but was unsuccessful because the lung had hepatized and would not expand. The patient never became completely awake. He could be roused, but immediately relapsed into a stuporous state. He died about 24 hours after operation.

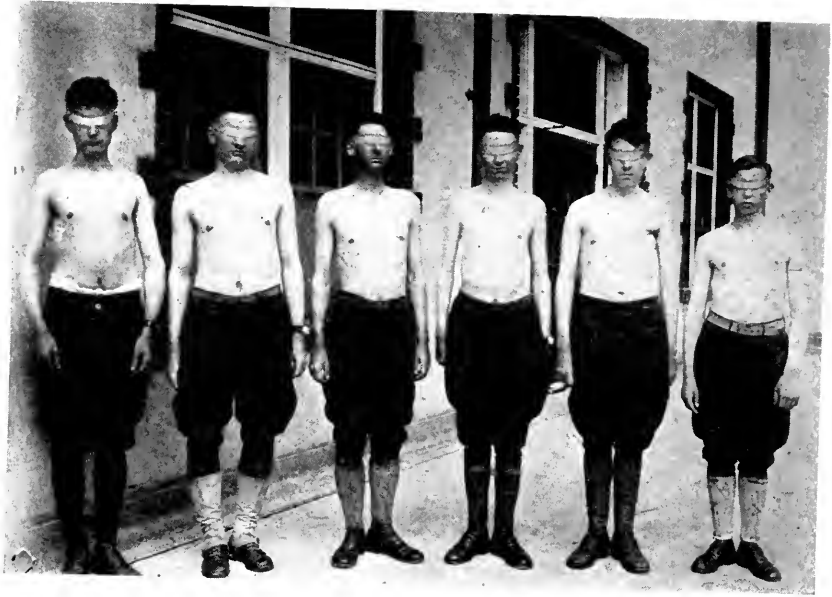
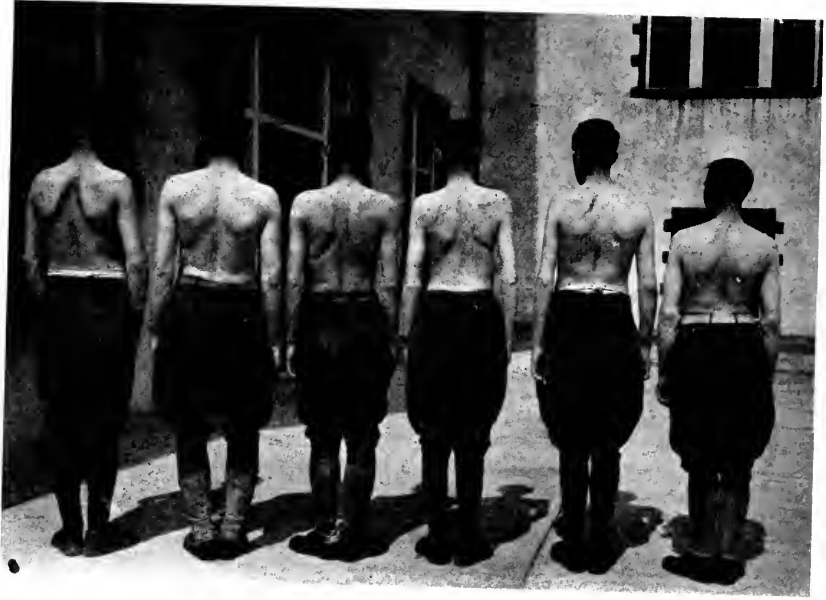


FIG. 9.—1. Pt. C. Radical operation, June 5, 1919. Portions of ribs removed, 7th, 8th, 9th. Healed, July 9, 1919. 2. Pt. P. Radical operation, June 13, 1919. Portions of ribs removed, 7th, 8th, 9th. Healed, July 13, 1919. 3. Pt. P. Radical operation, May 28, 1919. Portions of ribs removed, 6th, 7th, 8th, 9th. Healed, July 21, 1919. 4. Pt. H. Radical operation, June 6, 1919. Portions of ribs removed, 6th, 7th, 8th, 9th. Healed, July 22, 1919. 5. Pt. Mc. C. Radical operation, May 19, 1919. Portions of ribs removed, 4th, 5th, post., 3rd, 4th, ant. Healed, July 14, 1919. 6. Pt. S. Radical operation, May 19, 1919. Portions of ribs removed, 5th, 6th, 7th, 8th. Healed, July 3, 1919.

# RADICAL OPERATION FOR CHRONIC EMPYEMA

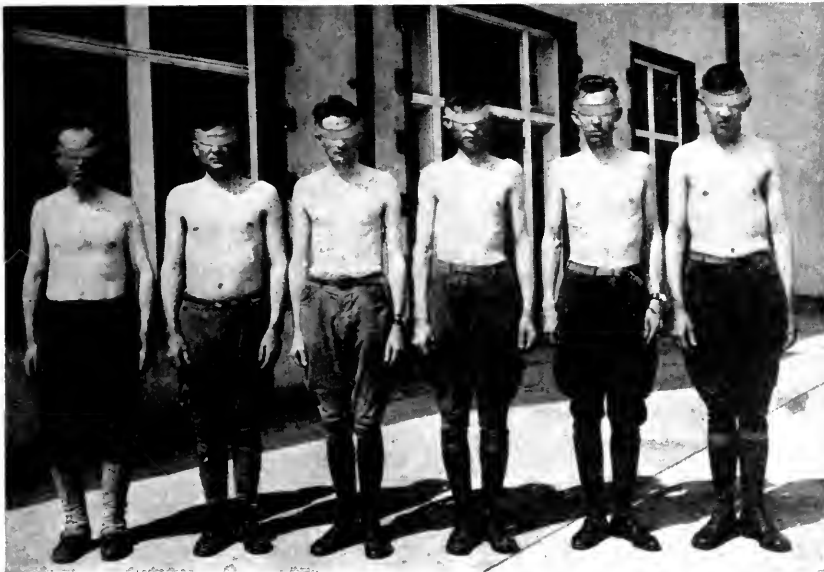
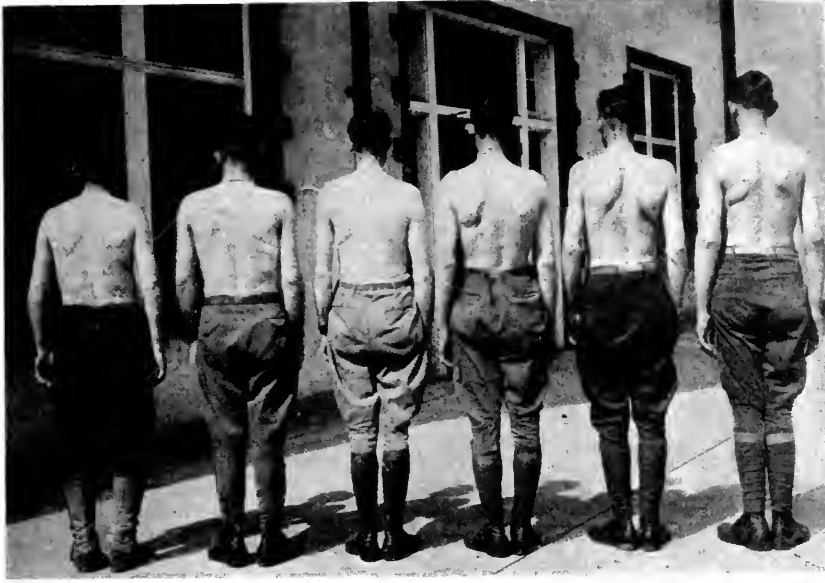


FIG. 10.—1. Pt. J. Radical operation, May 24, 1919. Portions of ribs removed, 7th and 8th. Healed, July 20, 1919. 2. Pt. R. Radical operation, June 9, 1919. Portions of ribs removed, 6th, 7th, 8th, 9th. Healed, July 7, 1919. 3. Pt. S. Radical operation, May 3, 1919. Portions of ribs removed, 9th and 10th. Healed, July 22, 1919. 4. Pt. C. Radical operation, May 24, 1919. Portions of ribs removed, 6th, 7th, 8th, 9th. Healed, July 20, 1919. 5. Pt. P. Radical operation, June 16, 1919. Portions of rib removed, 6th, 7th, 8th. Healed, July 22, 1919. 6. Pt. W. Radical operation, June 6, 1919. Portions of ribs removed, 6th, 7th, 8th, 9th. Healed, July 23, 1919.

The autopsy showed œdema of the lungs, interstitial hemorrhage into the lung, cardiac hypertrophy, cirrhosis of the liver and an acute exacerbation of a chronic nephritis.

The cause of death was given as œdema and interstitial hemorrhages of the lungs following anæsthesia.

We have had the feeling that death in this case was due to the anæsthesia and not the operation.

*Group V.—Cases with a chronic open pneumothorax.*

The difference between a chronic empyema cavity and a chronic open pneumothorax is that in the former case we are dealing with a cavity overlying a compressed lung, while in the latter we have a cavity overlying a collapsed lung. The two conditions differ in their development and in their pathology. In chronic empyema the lung gradually becomes compressed as the fluid accumulates. Release of this fluid will usually allow the lung to reexpand. It is for this reason that by far the greater number of all empyema cases recover by simple drainage. Only those cases, in which there is an obstacle to healing, will become chronic and only a small percentage of these will require a radical operation.

In chronic pneumothorax, on the other hand, the entire lung of one side has collapsed. There are two reasons for this: (1) A too early operation before adhesions have formed. (2) Perforation of a lung abscess, producing a pyopneumothorax. Both conditions produce a collapse of the lung toward the mediastinum. If the condition is recognized early, it may be overcome by the use of blow-bottles, arm exercise and deep breathing unless there is a large bronchial communication. Later, however, fibrous changes take place in the lung and no amount of blowing will expand it. These patients have to be subjected to a radical operation. The X-ray with bismuth filling in these cases always shows a long cavity, running from the diaphragm to the apex, as illustrated by Fig. 11.

Because of the changes in the lung itself, the aim of the operation is primarily mobilization or even collapse of the chest wall, and secondarily, mobilization of the lung. In several of our cases we had succeeded in establishing sterility of the cavity, in others it was absolutely impossible. In spite of sterility, however, healing failed to take place. By the time the radical operation is performed nature has done all she can do to obliterate the cavity by drawing in the ribs, pushing up the diaphragm, and pushing or drawing out the lung as far as it will go, or even displacing the mediastinum to the affected side, with compensatory hypertrophy of the opposite lung. The operation should be looked upon as an aid in helping nature complete her task, and it is therefore planned chiefly to produce mobility of the chest wall. In general it follows the principles described under the treatment of chronic empyema. A long skin and muscle incision is made and short pieces of from four to eight ribs are then resected; of the upper ribs only one-half to one inch are often removed, just enough to allow the chest wall to draw inward. That this represents nature's effort is

shown even during the operation, when it can be noted that divided ribs will overlap, or if a short piece is removed, the ends will at once approximate. After removing the outer wall of the cavity, the further course depends on the condition of the patient. Because the resection of the chest wall is usually extensive in these cases, it may be well to interrupt and to divide the operation into two stages. However, if conditions are favorable, one may proceed at once to mobilize the lung and attempt to decorticate. The latter is often very difficult or impossible because fibrous tissue-bands



FIG. 11.—Chronic pneumothorax. Filled with bismuth, showing straight vertical cavity extending from the diaphragm to the apex of the thorax.

extend from the pleura into the lung substance. Even if no decortication is possible, the lung should be freed completely around its margin. In this connection I wish to note that in all patients with complete lung collapse on whom I have operated, the lung had not shrivelled up towards the hilus like a sponge, as is believed by many, and as is sometimes graphically illustrated in articles on the subject. It has always been found collapsed towards the entire length of the mediastinum, adherent to the diaphragm below, and to the upper part of the thorax above. In the X-ray the visceral pleura is shown as almost a straight vertical line. Only once have I seen a lung collapsed and shrivelled up towards the hilus, that was in a case with a very extensive exudate, unrecognized for almost two years. After mobilization of the lung, and more or less complete decortication, the further treatment is like that of other chronic empyema cases. The wound is closed by approximating muscles and skin, and instituting drainage at the most dependent part. The use of blow-bottles is started early and is persisted

in. Owing to the extent of the wound, and the fact that decortication may have been incomplete, it usually becomes necessary to maintain drainage for some time and to institute Dakin-Carrel treatment. These pneumothorax cases are among the most rebellious, and constitute a serious problem. It is my belief that patients with a chronic open pneumothorax may be healed by simple drainage assisted by exercise and the use of blow-bottles, if recognized early. Once well established, I believe these patients should be subjected to a radical operation early, at a time when something may still be expected from

reëxpansion of the lung, before fibrous changes have taken place.

We have treated fifteen cases of this type, and have succeeded in healing seven. Patient M., Fig. 13, represents a typical case, with the resection of parts of seven ribs. Four patients are known not to be healed, and one we have not heard from. Of this small group of fifteen cases three died, and although we found an acute dilatation of the stomach in one case, which may have contributed to his death, and we were dealing with a known tertiary



FIG. 12.—Chronic empyema of twelve years duration showing small recess at anterior extremity of costophrenic sinus, filled with bismuth. Picture also shows nature's effort to obliterate cavity by overlapping of ribs like shingles on a roof.

syphilitic in another, I believe the actual cause of death in all three was shock. These patients were bad risks, but because they showed no tendency to get well, the operation was indicated. A less radical procedure at the time, doing only a partial operation, might have saved them. Short reports of these three cases follow.

Case Reports.—Patient H. G. Complete pneumothorax right, existing 8½ months. Had been on anti-syphilitic treatment. June 28, 1919, operation, resection of part of seven ribs with mobilization of lung. June 30, 1919, post-operative reaction good. Suddenly woke up out of a sound sleep, expressed fear, and went into a convulsive seizure resembling epilepsy. Exitus in about 10 minutes.





FIG. 13.—Typical chronic pneumothorax healed after radical operation. Portions of seven ribs were resected and a complete decortication was done.

Autopsy showed cerebral œdema, syphilitic aortitis with calcarous deposits and beginning thrombus formation.

Patient W. B. Complete pneumothorax of two years duration. Has had many operations without improvement. August 9, 1919, operation, resection of portions of seven ribs. No mobilization of lung attempted on account of poor condition. Death after 28 hours from shock. Examination of the affected lung showed that it still contained some air, but that bands of fibrous tissue extended from the pleura into the depth and prevented expansion.

Patient C. B. Pneumothorax for 15 months. Had been operated on five times. Had three openings into the chest, one anteriorly, and two posteriorly. Bronchial communication present. August 25, 1919, resection of pieces of 8 ribs, which was very difficult on account of extensive fusion. Lung mobilized but not decorticated.

Next morning he looked very hopeful, but while turning onto his side he died suddenly. Autopsy showed an acute dilatation of the stomach containing 1300 c.c. greenish fluid.

*Group VI.—Cases with bronchial or pulmonary communication.*

In an article on the treatment of bronchial fistulæ,‡ I have described the different varieties of bronchial fistulæ and divided them into broncho-pleural and broncho-cutaneous. The latter have to be closed by surgical means, while the former usually close spontaneously as healing of the cavity progresses. A certain number of these, however, are responsible for the persistence of a chronic empyema cavity, and have to be treated. It has been found that all patients in whom a broncho-pleural or pulmonary-pleural communication was diagnosed, either clinically or by actual observation during a radical operation, would heal after such an operation. It seems well established therefore that the mobilization and decortication of the lung removes the mechanical factors preventing closure of the fistula. For this reason all these cases are included in the group of chronic empyema described above.

The six broncho-cutaneous fistulæ encountered have been described in detail in the paper mentioned above. They are all healed. There was a seventh case, which ended fatally, the record of which follows:

Case Report.—Patient L. M. had influenza in October, 1918, followed by empyema. Two operations had been done, resection of the 6th rib anteriorly and the 9th rib posteriorly. Both openings communicated with bronchi and both discharged pus in large amount. The patient had been kept under treatment with the intention to improve his general condition, but without result. He was a physical wreck.

June 16, 1919, operation was undertaken to establish better drainage. A complete pyopneumothorax was found, divided into several compartments. In order to drain them all, portions of six ribs were removed. Both fistulæ were found to enter the lower lobe. Nothing was done but to establish drainage.

The patient died the same day of shock. The autopsy showed a complete pyopneumothorax, and a partially necrotic left lower lobe, containing an abscess the size of a hen's egg. Three fistulæ led from this abscess to the surface of the lung.

---

‡ The Treatment of Bronchial Fistulæ, Carl Eggers, ANNALS OF SURGERY, September, 1920.

*Group VII.—Cases with tuberculosis.*

Among any larger group of patients with chronic empyema one may encounter several with tuberculosis of the lung, the pleura, or both. If, in spite of the establishment of good drainage, thereby cutting down the absorption of septic material to a minimum, and after other complications have been ruled out, chronic empyema patients continue anæmic and underweight for any considerable period, tuberculosis has to be considered. But even though suspected, many months often elapse before the true nature of the disease is recognized or proven by laboratory tests. Owing to a thickened pleura and other intrathoracic changes the X-ray frequently fails, and one has to rely on sputum examinations or bacteriological examinations of the discharge from the sinus. Occasionally an excised piece of tissue from the wall of the sinus establishes the diagnosis. Owing to these diagnostic difficulties patients with tuberculosis are sometimes subjected to radical operation before the true nature is recognized. We have seen such an operation lead to cure of the empyema while the intrapulmonary disease continued. In other cases, healing failed to take place. Among the series here reported there were eleven cases in which positive evidence of tuberculosis was obtained after radical operation. Of these 11 cases, 3 are healed, 1 healed and died one year later, 1 is not healed, 3 did not heal and later died, 3 have not been heard from. Because they were not recognized before operation, these patients are included in the group of 99 chronic cases described above.

I wish to call special attention to patients who were known to be tuberculous and in whom operation was deliberately undertaken with a view to curing them in this manner. I have had six such cases in the last few years. Three of these have healed and are apparently also cured of their intrapulmonary focus. One is at present under treatment, one is in a government sanitarium, and one has not been heard from. This subject will be reported on in more detail at a later time.

## CONTRAINDICATIONS TO OPERATION

As long as there is a reasonable chance that patients may be cured by more conservative means, radical operation should not be attempted.

A septic state, as evidenced by anæmia and underweight, lack of tone, and a rapid heart, is a contraindication. In such patients the general condition must first be improved by adequate drainage, sterilization of the cavity, and attention to exercise and hygiene.

Complications in other organs, as endocarditis, myocarditis or nephritis, may contraindicate a radical intervention. One must judge each case carefully.

In the presence of active pulmonary tuberculosis one should certainly not attempt any extensive operation, but by choosing an anæsthetic carefully,

or even operating under local anaesthesia, good results may be obtained as soon as the intrapulmonary focus has quieted down.

## DANGERS AND COMPLICATIONS

Shock is a condition brought about by carrying the operation beyond the threshold of safety, or to hemorrhage, or both. If the patient has been carefully studied, and the operation planned in advance, one can work expeditiously and not lose time deliberating during the operation. One should never attempt more than the patient can stand. Therefore one should interrupt the operation at any time when it is realized that carrying it to completion would involve grave risk, and continue it at another time. Operations on the left side have always impressed me as being more dangerous than those on the right.

Hemorrhage must be guarded against, both at the time of and after operation. It is the chief factor in producing shock. Considerable bleeding is often encountered during rib resections, especially in old cases with reformed bone. Intercostal vessels must be carefully ligated. The best method is to use catgut on a strong, curved needle and to ligate the vessels with some muscle tissue a short distance behind the bony ends. We have had rather excessive post-operative oozing in a few cases, necessitating opening of the wound and packing it. In two patients there was severe hemorrhage, which became alarming in one. Both reacted to proper treatment.

In a few of our cases the diaphragm was accidentally entered, because it was difficult to differentiate between it and inflammatory tissue. As soon as the condition was recognized the damage was repaired by interrupted chromic-gut sutures, and in no case has it led to trouble later on.

While doing decortications the lung parenchyma was damaged in several cases, causing bleeding and escape of air. This usually happened in those patients in whom it was difficult to separate the inflammatory layer from the visceral pleura. No permanent lung injury has resulted from that in any case. Bleeding was usually controlled by hot packs, in other cases by fine catgut sutures. No lung fistula resulted in any case, because the damage was always superficial in character.

Subcutaneous emphysema was encountered in only two cases, and in neither did it assume alarming proportions.

Although one might expect pneumonia to develop in some of these patients, due to handling of the lung, we had to deal with this complication in but two cases, in one on the operated side, in the other on the opposite side. Both patients recovered.

In one case we had a paralysis of the arm on the normal side, probably due to pressure on the brachial plexus. This happened in spite of the fact that in all patients precautions were taken to avoid such an accident. The

position as shown in Fig. 3, with the lower arm placed over the head, effectually prevents pressure on the plexus.

### DEFORMITIES

When the subject of extensive rib resections is mentioned, one is apt to have visions of terrible deformities with extensive collapse of the chest wall, such as have been published in old text-books. There is no doubt that in some cases this is unavoidable, but in the great majority of the cases here reported the resulting deformity is slight. There are a number of reasons for this.

1. The portions of rib excised are usually short, from two to four inches long, and still shorter in the upper thorax. Even if longer, very little deformity usually results except in those patients in whom parts of the lower thorax are removed, allowing the diaphragm to draw the entire lower chest inward.

2. A complete muscle suture of all the layers, followed by a skin suture, does much to prevent deformity.

3. Reliance is placed not on collapse or mobilization of the chest wall, but rather on the reëxpansion of the lung. It is for this reason that so much care is taken to remove all of the empyema wall.

4. Patients are not allowed to remain long in bed in a cramped position. They get out on the third to the seventh day and are encouraged to breathe deeply and use blow-bottles early. They are instructed to stand in front of a mirror to see that their shoulders are of equal height, to draw them back and then breathe deeply.

5. Nearly all the patients are adults, and their bony framework is rather firm. They have been accustomed to carry themselves erect, and if they are allowed or encouraged to use their muscles early, they will maintain themselves in good position.

6. This erect position is later partly maintained by bony bridges which form from one rib to another, at their spinal ends, and practically splint the chest, keeping the ribs separated and preventing a complete collapse and curvature of the spine. These bony bridges can be seen by means of the X-ray as early as six weeks after operation. Later they become very firm and give strong support (Fig. 14). All deformities should not be attributed to the radical operation, for it must be borne in mind that many chronic empyema patients have deformities, from long-continued drainage and improper carriage, before they are subjected to radical operation. They have flattening of the chest on the affected side, with immobility, and frequently curvature of the spine and elevation of the shoulder. A radical operation often decidedly improves such deformities, because it does away with the fixation of the chest, and allows patients to straighten up and breathe deeply.

## RESULTS

Among 146 patients with chronic empyema subjected to radical operation of the nature described in this paper there was an operative mortality of five, or 3.4 per cent. There are six other deaths to be reported which occurred a year or more after the operation. Four of these were in patients with tuberculosis, the same ones reported under that sub-heading, one in an

unhealed patient who still had four machine-gun bullets in different parts of his chest at the time of death, and one in a healed patient who contracted pneumonia of the opposite lung one year after healing. None of these deaths are directly traceable to the operation.

This method of operating can be advocated because it gives excellent access, it removes all infected tissue, thereby preventing recurrence, and it minimizes deformity.

That the muscle power is good, even after very extensive operations, is due to the fact that the

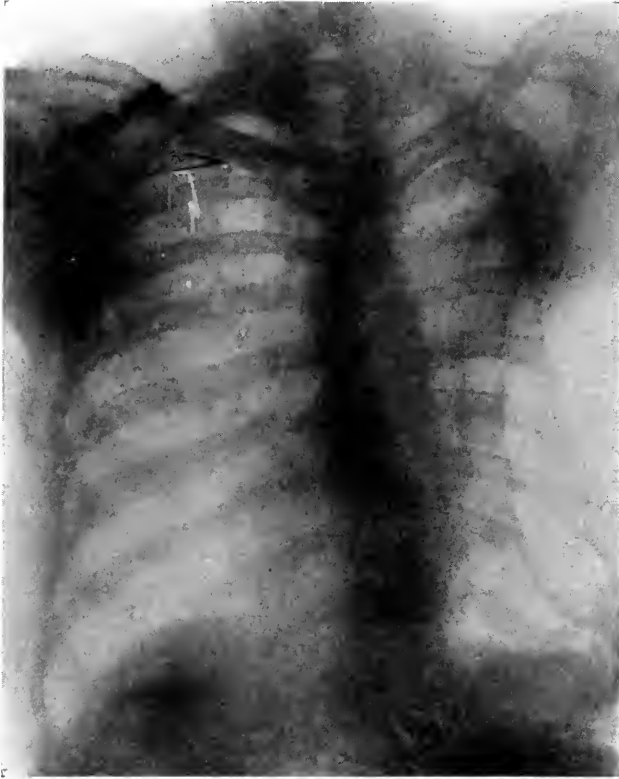


FIG. 14.—X-ray shows bony bridges which have developed between the ends of adjoining resected ribs. They prevent collapse and splint the chest wall.

muscles are immediately sutured and that patients are encouraged to use them early.

Figures 15, 16 and 17 illustrate what patients are able to do.

Their general well-being is materially improved, and though some patients continue to complain of pain in the chest and dyspnoea on exertion, the great majority state that they feel better, that their lungs expand, and that they are less dyspnoeic. They can breathe deeply because the fixation of the thorax and lung have been removed.



FIG. 15.—Patient A. B. Final result after radical operation in a patient who had empyema for twelve years.



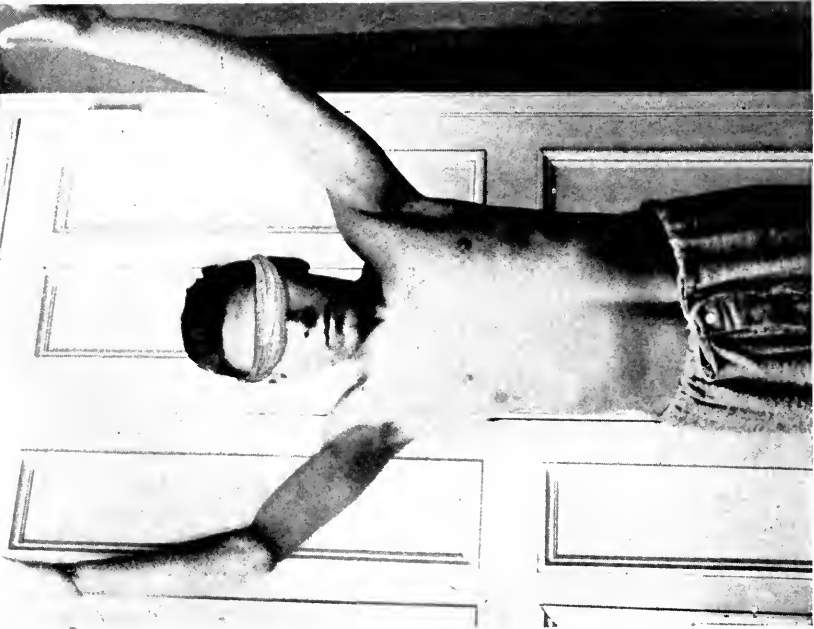
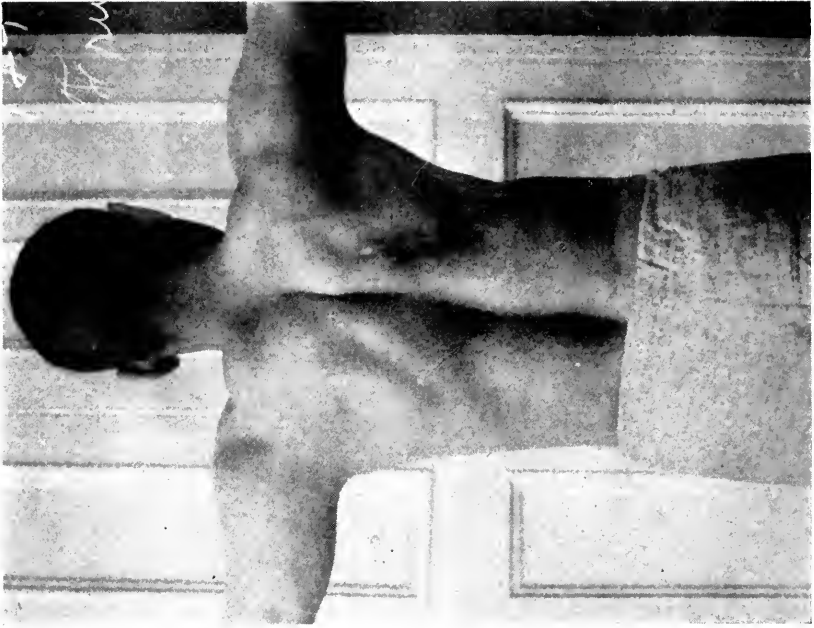


FIG. 16.—Patient A. F. Showing good functional result after a typical radical operation with decortication of the lung.



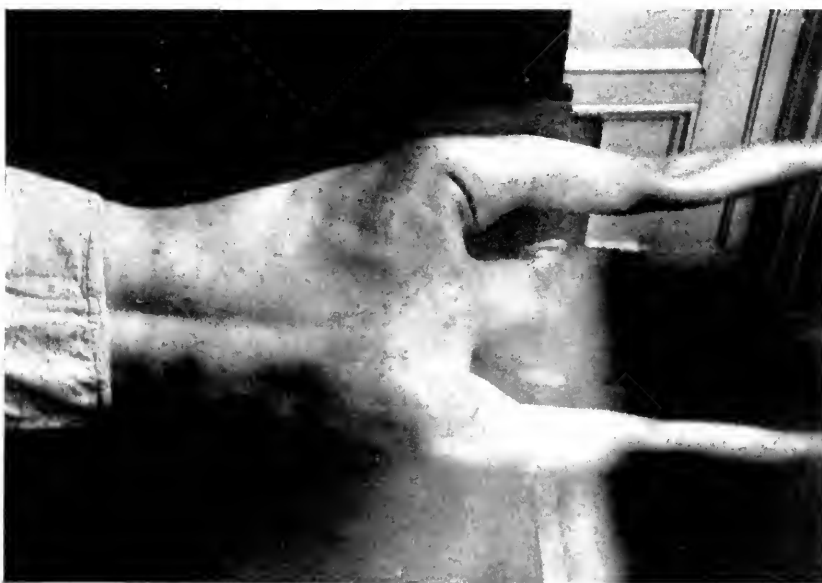


FIG. 17.—Patient R. E. Showing final result after several radical operations had been done with resection of portions of six ribs.

## TERATOID MIXED TUMORS OF THE BREAST\*

REPORT OF A CASE

By MONROE ANDERSON McIVER, M.D.

OF BOSTON, MASS.

RESIDENT SURGEON, MASSACHUSETTS GENERAL HOSPITAL

TUMORS of the breast containing bone and cartilage have long been recognized and have always excited considerable interest. Velpeau<sup>1</sup> refers to cases described by Morgagni, Wolf and Bonnet; but the first case to attract widespread attention was one reported at length by Sir Astley Cooper<sup>2</sup> in 1829.

This case has become traditional in the literature, and references to it may be found in practically every standard treatise on tumors of the breast from the time of Nelaton<sup>3</sup> to the present. Deaver and McFarland<sup>4</sup> in 1917 were able to collect about two dozen cases of mammary tumors showing cartilage and sometimes bone as important constituents.

In attempting to classify the case of mixed tumor of the breast presented in this report, the terminology employed by Ewing<sup>5</sup> in his recent monograph on neoplastic diseases has been adopted. The term teratoma as applied to tumors of the breast has found its way into the literature to only a very slight extent. No case was found in the *Index Medicus* reported under that title, although the conception that these neo-



FIG. 1.—Gross appearance of the portion of the tumor showing teeth and alveolar process.

plasms arise from embryonal rests is not new. Wilms,<sup>6</sup> in 1902, in his classical monograph discusses mixed tumors of the breast, and concludes that their derivation is to be referred to the earliest period of differentiation of the three germ layers; and more recently this view has been strongly championed by various French writers, notably Nadal<sup>7</sup> and Menetrier.<sup>8</sup>

\* From the service of Dr. Franklin G. Balch.

## TERATOID MIXED TUMORS OF THE BREAST

The tissues of the breast are capable of undergoing extensive metaplastic changes and, according to Cornil and Petit<sup>9</sup> these mixed tumors are considered to arise locally by a process of metaplasia.

Since such different types of neoplasms, varying from the most complex mixed tumors containing bone, cartilage, and squamous epithelium, to the very simple types in which one kind of tissue predominates, as in the osteomas and chondromas, may be considered as belonging to this group of teratoid mixed tumors, it is not remarkable that there is difference of opinion as to their etiology.

This case is reported with the view of putting this rather unusual neoplasm on record, and in the hope that it may possibly throw some light on the origin of these mixed tumors. No case was found in the literature on neoplasms of the breast in which teeth were noted.

According to Ewing<sup>10</sup> these tumors are slow growing and comparatively harmless, yet carcinomatous and sarcomatous metastases are sometimes observed reproducing the original structure.

The patient whose case is presented in this report entered the Massachusetts General Hospital February 3, 1922.†

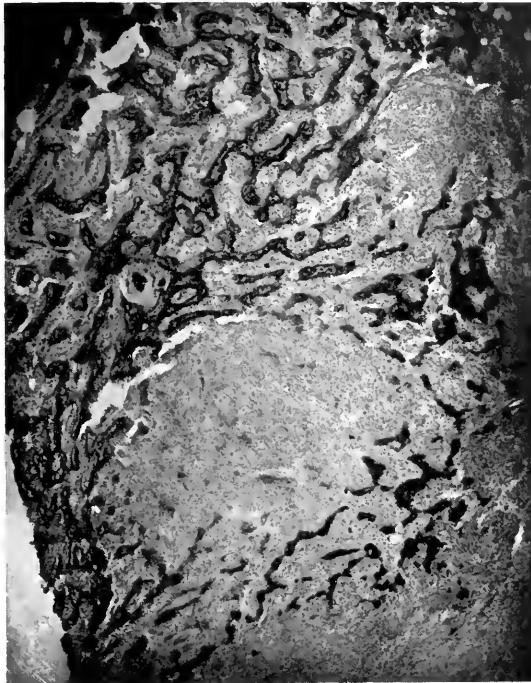


FIG. 2.—Low power appearance of the trabeculae of osteoid tissue scattered through the tumor.

*Case Report.*—G. E. H., Hospital No. 247784. An American housewife, sixty years of age. General health has always been good. For the past several years she has suffered from slight dyspnoea on exertion, and she has noticed some swelling of her ankles. Three months ago the patient first noticed a lump the size of a walnut in the right breast. She consulted her family physician at once, who advised operation, but she refused. Since that time she thinks that the mass has increased in size, and she is conscious of an almost constant dull, aching pain, localized just over the tumor. Her general health she considers to be good. No loss of weight; present weight 240 pounds.

A very obese woman. The general physical examination is otherwise negative,

---

† For permission to publish this case, I am indebted to the operating surgeon, Dr. Beth Vincent.

except for persistent moist râles at the bases of both lungs, and rather marked varicosities of the veins of both legs. Blood-pressure 160/100.

Breasts.—In the upper outer quadrant of the right breast, a hard, firm mass, about the size of a small orange, can be palpated. The tumor appears to be situated rather deeply in the substance of the breast. The skin is not firmly adherent, but there appears to be some attachment to the underlying mass. No retraction of the nipple is noted. No enlarged glands can be palpated in the axilla, but the examination is rather unsatisfactory because of the obesity of the patient. The left breast appears to be normal.

Diagnosis.—A diagnosis of carcinoma of the breast was made, although it was realized that certain aspects of the case were not altogether typical, notably

the relatively small amount of attachment to the skin in comparison to the size of the tumor.

Operation.—Because of the obesity of the patient and the pathology noted in the lung, the operation was carried out under local anaesthesia. The axilla was dissected and the entire breast removed. On section of the breast, a hard bony tumor was found, measuring about 10 cm. in diameter. In the centre of this tumor an alveolar process with teeth was discovered. The gross appearance of this unusual specimen is shown in Fig. 1. The micro-

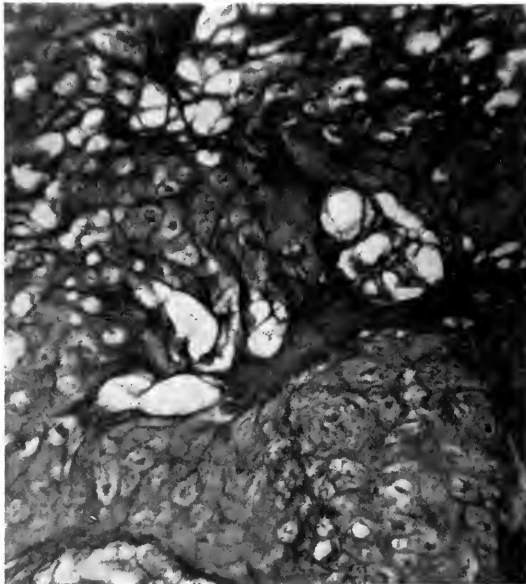


FIG. 3.—An area of cartilage.

scopic appearance of the bony and cartilaginous areas scattered through the tumor will be seen in Figs. 2 and 3.

Post-operative History.—The wound showed evidence of infection within forty-eight hours, necessitating the removal of a few stitches and the establishment of drainage. Because of the excessive amount of fat tissue this local sepsis proved rather slow in clearing up, and although the patient's general condition was considered to be satisfactory, she was still receiving daily dressings and showed some evening elevation of temperature when she died suddenly thirteen days after operation with symptoms suggesting pulmonary embolism. No autopsy could be obtained.

Pathological Report by H. C. Hartwell, Pathologist:

"Specimen, breast with axillary contents attached. The breast on section shows a hard spherical tumor in its outer hemisphere, surrounded by the fat of the breast. The tumor is about 10 cm. in diameter and has a fibrous, grayish-

## TERATOID MIXED TUMORS OF THE BREAST

white surface, a large portion of which is of bony hardness. In one area an alveolar process with teeth can be made out. The surrounding breast itself is fibrous with cysts. There are a few soft lymph-nodes in the axillary contents.

"Microscopic examination shows a nondescript connective tissue which in places is cell-rich and shows numerous mitotic figures. There are trabeculae of osteoid tissue scattered through it and an occasional area of cartilage. There is no evidence that the tumor is malignant. The axillary lymph-nodes are normal.

### REFERENCES

- <sup>1</sup> Velpeau: Treatise on Diseases of the Breast, 229, 1856.
- <sup>2</sup> Cooper: Illustrations of the Diseases of the Breast, 64, 1829.
- <sup>3</sup> Nelaton: Traite des tumeurs de la Mamelle, 44, 1839.
- <sup>4</sup> Deaver and McFarland: The Breast; Its Anomalies, Its Diseases, and Their Treatment, 358, 1917.
- <sup>5</sup> Ewing: Neoplastic Diseases, 499, 1922.
- <sup>6</sup> Wilms: Die Mischgeschwulste, 182, 1902.
- <sup>7</sup> Nadal: Rev. de Chir., 629, 1912.
- <sup>8</sup> Menetrier: Bull. Assoc. franc. etude. cancer, 173, 1910.
- <sup>9</sup> Cornil et Petit: Soc. Anat., 23, 1905.
- <sup>10</sup> Ewing: Neoplastic Diseases, 1922.

## RUPTURE OF THE LONG HEAD OF THE BICEPS FLEXOR CUBITI MUSCLE

By NELSON AMOS LUDINGTON, M.D.

OF NEW HAVEN, CONN.

It is desired to stimulate interest in this lesion in the belief that it is both more common than is generally supposed and more readily amenable to surgical treatment than the brief and discouraging text of standard treatises indicates; to present a new diagnostic test for its recognition, and to distinguish between those cases in which the lesion is due to trauma and those in which it is due to disease.

*CASE.*—J. H. Millwright, fifty-six years old. Fourteen weeks ago was lifting one end of a box (weight,  $31\frac{1}{2}$  pounds) from the floor onto the rear end of a truck when he experienced a "sudden sharp pain like a knife" in the right upper arm and shoulder. His arm fell to his side and he dropped his end of the box. The pain was of brief duration and he continued at work using his left hand only. In a few hours the pain gradually returned, increased in severity, and lasted two weeks, during which time he carried his arm in a sling.

He was unable to resume his work on account of soreness in the shoulder and a loss of power in flexing the right forearm beyond a right angle. He has difficulty in abduction, and the weakness, both in flexion and abduction, has been progressive, and has not been benefited by treatment. He has never noted swelling, discoloration, or deformity in the arm or shoulder.

*Past History.*—Lumbago seventeen years ago. Alleged gall-stone attack nine years ago. No muscle or joint pains. No previous trauma. Alcohol and tobacco in moderation.

*Examination.*—Powerful muscular type. The general physical examination is entirely negative. In the right shoulder joint there is a distinctly palpable and faintly audible "creak," a point of tenderness just under the tip of the acromion, and a limitation of voluntary abduction, circumduction, and backward extension. There is slight atrophy in the upper arm and efforts at abduction reveal a slight hollow on the anterior surface of the arm immediately below and parallel to the anterior edge of the deltoid. Huters-sign is absent. The belly of the biceps when contracted is soft. The tendon of the long head could not be palpated. The arms being symmetrically abducted with the forearms fully flexed, it is noted that the biceps bulge on the affected side is further away from the deltoid and more abrupt in its rise than that on the sound side.

It is desired at this point to call attention to the following diagnostic test, which was positive in this case, and which the writer believes has not previously been recorded.

The patient was directed to rest his folded hands, palms down, on the top of his head and allow the interlocked fingers to support the weight of the arms. In this position there is maximum relaxation of the long head. The examiner then places two fingers on the tendon of the long head of the biceps in each arm as is shown in figure one, and directs the patient to simultaneously contract and relax his biceps muscles. The contraction of the long head tendon on the sound side is plainly felt while it is absent on the affected side if the tendon is ruptured.

## RUPTURE OF BICEPS FLEXOR CUBITI

Influenced very considerably by the results of this test, operation was done eighty-five days after injury. The tendon presented normally but under less than the usual tension when lifted from its bed. It was followed up through a normal bicipital groove and found to be torn about four-fifths across at its origin. The remaining fifth was divided with scissors. Owing to adhesions about 2 cm. below the groove a portion of the sheath was removed with the tendon which was amputated close to the fleshy portion of the long head. A slit about four cm. long was made in the short head. Into this slit the stump of the long head was sutured, under slight tension, with No. 2, chromic gut, the forearm being held in right-angled flexion. The wound was closed without drainage.

The after treatment consisted of immobilization in right-angled flexion for fourteen days; massage and passive motion until the twenty-eighth day, when all dressings were removed and active motion encouraged.

Ten weeks after operation he was able to work half a day at manual labor, and at the end of fourteen weeks he had resumed his previous occupation, working full time and without disability.

I am indebted to Doctor Moies of the Brady Laboratory for Pathology associated with the Medical Department of Yale University for the following report of the results of a careful study of the specimen submitted.

"Pathological Report, M220-21. The specimen is the long head of the biceps muscle. One end is ruptured and the edge is somewhat fringed out. There is a small hard nodule just above the middle portion. Microscopically: sections were made from the upper portion, through the hard nodule and through the distal end. In the proximal end the blood-vessel walls appear somewhat thickened. The hard nodule shows a very dense hyaline-like tissue. The section from the distal end shows no marked abnormality. Diagnosis: ruptured biceps tendon." (Fig. 2.)

We may classify these cases in two ways, according to their etiology and according to the pathological findings. Etiologically, they are either spontaneous or traumatic. Pathologically the site of rupture is either in the bicipital groove or outside the groove. Those cases in which the rupture is in the groove are spontaneous, and those in which the site of rupture is without the groove have a history of trauma.

The antecedent pathology of rupture in the groove has been clearly set forth by Borchers,<sup>1</sup> while that of rupture outside the groove is as yet a debatable subject, not only as to its character but as to its existence as well.

Davis says,<sup>2</sup> "The tensile strength of healthy tendon is so great that it is my belief that true rupture is much rarer than is usually supposed, and that when a tendon does rupture it is very likely to have been diseased." Keen<sup>3</sup> agrees with this view. Keen, Davis, Bryant (quoted by Davis), and Alexander<sup>4</sup> all associated this lesion with arthritis deformans in a general way.

Borchers, however, goes into details. He gives the credit for demonstrating the causative relation of arthritis deformans, to Ledderhouse, who made a number of dissections and found that in cadavers of moderately advanced age, 50 per cent. showed some lesion about the shoulder joint, characteristic of arthritis deformans. The same was true of ten out of fifteen older bodies. Ewald, stimulated by Ledderhouse's findings, pursued the subject both along clinical and radiologic lines and corroborates Ledderhouse. Both agree that the exostoses of arthritis deformans first and more promi-

nently appear about the shoulder joint in the region of the tuberosities and along the bicipital groove. Radiograms, however, failed to show characteristic change in many cases in which the clinical evidence was unmistakable.

Borchers' exposition of the sequence of pathological events leading up to spontaneous rupture of the tendon is briefly, in substance as follows: "

Osteophitic outgrowths appear on the tuberosities of the humerus and grow towards each other, thus tending to convert the groove into a canal. The same process takes place in the floor of the groove and along the bicipital

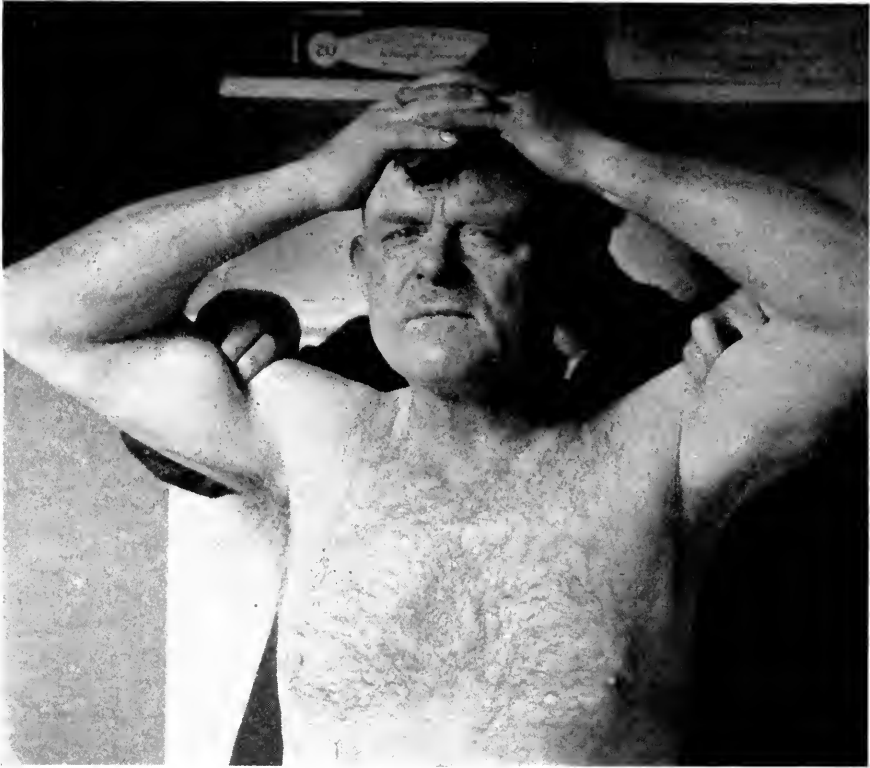


FIG. 1.—Showing position of arms and examiners fingers in testing for ruptured long head triceps tendon.

ridges. These outgrowths are at first smooth, rounded excrescences; later they add a sharply pointed top or spicule.

Three possibilities at once become apparent:

1. If the growth from the summits of the ridges is the more rapid, the groove may be covered over, converted into a canal, and the tendon imprisoned therein.
2. If the growth from the floor of the groove is the more rapid it may fill the groove and mechanically dislodge the tendon from its bed.
3. In either event the early formation of spicules may cause the tendon to chafe itself through incident to its back-and-forth motion in the groove.



Gurlt (quoted by Ewald) found one case of dislodged tendon and one case of imprisoned tendon. Similar instances are referred to by Cruveilhier. This seems to account for spontaneous rupture in the groove very clearly, but leaves ruptures outside the groove unexplained but for a tentative hypothesis of "obliterating endarteritis" put forward by this same author.

In the cases classed from their history as traumatic, the rupture has always been found outside the groove and most usually above the groove adjacent to, or at, the origin of the tendon. Two cases were found in which the rupture was below the groove. In one the patient grasped a rapidly revolving fly-wheel, with the resultant rupture at the junction of the tendon and belly of the long head. It is fair, in this instance, to assume that the maximum tension came on the long head with the forearm quite extended and the humerus so drawn away from the body as to permit the long head to pass from its insertion to its origin in a straight line, instead of lying on and following the curve of the humeral head, as would usually be the case in lifting. The rupture therefore occurred at the recognized weak point of the flexor mechanism, *i.e.*, the junction of tendon and muscle belly, because the mechanical conditions were such as to equalize the distribution of strain. In the second case of rupture below the groove there was a history of repeated direct trauma to the tendon at the site of its rupture and at operation "a fusiform ecchymotic swelling was found" <sup>5</sup> which undoubtedly diminished its tensile strength.

Cases of a direct solution of continuity of tissue from a direct trauma, such as a sabre cut, are intentionally omitted, as they have no bearing on the question under discussion.

The literature affords meagre data on the pathology of tendons. The operative findings in these cases have been varied, as follows:

A fusiform hemorrhagic swelling and adhesions to the sheath.

No tendon at all as far up as the groove (operation seven weeks after injury).

An inch and a half of cicatricial fibrous tissue. Four years after injury.

A small fibrous cord. Six months after injury.

No pathological study of these tendons is recorded. In the study of the tendon submitted to Doctor Moies there is no definite reason shown for its rupture. The origin of the adhesions and the dense hyaline mass is also unknown. Either or both of these abnormalities may have antedated the rupture or may have developed subsequently thereto. The arterial thickening in the proximal end of the tendon was negligible in its extent.

In the absence of definitely recognizable lesion in the tendon we may with propriety consider the possibility of mechanical rupture of the tendon above the groove.

It is usual to think of the stress in the flexor mechanism of the arm as beginning at the shoulder and expending itself at the elbow. But action and reaction are equal. Therefore let us consider the weight to be lifted as the power, applied at the elbow; the body bent forward and the humerus drawn well away from the side. Under these circumstances the long head tendon

is free of the humeral head and the tubercles of the humerus most nearly approach the glenoid rim. As the body straightens up the humerus swings down toward the side of the body, the tuberosities draw away from the glenoid and the tendon of the long head is deflected from a straight line and forced to lie on and be forced upward by the rounded humeral head.

The humerus becomes in effect a lever of the second class, the long arm of which is its longitudinal axis, with the weight being lifted acting as the power. The fulcrum is the point of contact of humeral head and glenoid. The short arm is the line from the fulcrum to the intertubercular humeral notch. The mechanical advantage of this leverage is about fifteen to one.

Omitting any discussion of the many mechanical factors which were worked out in studying this proposition, the conclusion reached is that the



FIG. 2.—The removed tendon. Note hyaline mass under  $1\frac{3}{4}$ -inch mark. Frayed-out end with hook in portion cut by scissors. Adherent sheath at 3-inch mark.

practical result of this leverage is a material increase in the strain on the tendon above the groove, the strain below the groove remaining constant.

As this is entirely in harmony with the operative findings it is reasonable to consider that rupture above the groove may be attributed to muscular effort alone. If there be present in the tendon or its sheath any condition which would impede the free passage of the tendon through the intertubercular notch, that condition would be favorable to rupture, and should be accorded recognition as a predisposing factor.

Keen (*loc. cit.*) reports a case in which the tendon was found intact but the periosteum and a portion of the margin of the glenoid was torn off. This is in fact a case of fracture of the scapula by muscular action. There is no longer any claim that such a condition involves previous disease of the bone. The claim of previous pathology when the rupture takes place at the origin would seem in this connection to be an attempt to explain a difficulty which does not exist.

If further observation shall support the foregoing, and two sites of rupture shall come to be recognized as having distinct etiological and pathological bases, then the clinical recognition of the site of rupture will have in

addition to its academic interest the further value of aiding in establishing the rights of the parties at interest in those cases which come within the domain of the Workmen's Compensation Laws.

Unfortunately a careful study of the situation makes it seem certain that any opinion as to the site of rupture based on clinical and radiologic findings is at best very unreliable. The history as it pertains to the character and degree of force being exerted at the moment of rupture is indicative only of the class to which the case may belong. The pain at the time of rupture is by its intensity also indicative only. Aside from these two indications all other symptoms are common to both classes, and it is certain that the site of rupture may be definitely stated only after it has been determined by operative procedure.

Regardless of the site of rupture, or the means by which it was brought about, the proper treatment is operation. Palliative measures offer no prospect of relief. The disability is permanent unless corrected by operative means. Excellent results have been obtained in all cases operated on at periods ranging from a few days to four years after the onset of the disability. The technic is that of a simple anatomical dissection. The risk is that of infection and should be minimum, as the conditions are entirely under the control of the operator. The necessary residence in hospital is brief and the usual period of recovery of full function has been in the neighborhood of three months.

## REFERENCES

- <sup>1</sup> Borchers: Beitr. z. klin. Chir., vol. xc, 1914, p. 636.
- <sup>2</sup> Med. News, 1895, vol. lxvii, p. 121.
- <sup>3</sup> Keen: ANNALS OF SURGERY, vol. xli, p. 756.
- <sup>4</sup> Alexander: ANNALS OF SURGERY, vol. lxi, p. 608.
- <sup>5</sup> Keen, *loc. cit.*
- <sup>6</sup> Beitr. z. klin. Chir., vol. l, 1914, p. 635.

## THE VALUE AND LIMITATIONS OF BLOOD TRANSFUSION\*

BY EDWARD W. PETERSON, M.D.

OF NEW YORK

THE therapeutic value of blood transfusion has received widespread attention and general recognition. Its limitations, however, have been somewhat obscured and ignored, and conclusions as to results obtained not adequately discussed and elucidated. In reviewing recent articles on blood transfusion the following features stand out:

(1) The necessity for safeguarding the operation by more careful preliminary compatibility tests, and the importance of finer qualitative estimations in order to secure the best clinical results.

(2) The superiority of unmodified blood over citrated blood, both as to immediate and late effects. Biologic tests appear to have settled this question.

(3) A tendency to discuss again the methods best suited for the transplantation of blood from one individual to another, in order to minimize biochemical changes and reactions.

One has but to refer to the articles of Unger,<sup>1</sup> <sup>2</sup> Drinker and Brittingham,<sup>3</sup> Bernheim<sup>4</sup> and Horsley-Vaughn-Dodson<sup>5</sup> for elaboration of these views. The writer has had a fairly large experience in blood transfusion work, and in this paper wishes to record some of his impressions and conclusions. Whole blood can be transplanted from one individual to another as homologous living tissue. Its further value lies in its hæmostatic and hæmatopoietic properties. In selected instances it may also have antitoxic and bactericidal powers. The one great outstanding indication for blood transfusion is anemia. If the anemia be posthemorrhagic—either acute or chronic, simple or pathologic—we have in blood the most efficacious of all agents, the remedy par excellence. If, on the other hand, blood be administered in blood diseases, infections, intoxications, metabolic diseases, or general debility, or for the anemia which may characterize or complicate such conditions, then we must have a clear understanding and an honest appreciation of the limitations of transfusion. In a previous article<sup>6</sup> the writer gave his results in the treatment of hemorrhage and the hemorrhagic diseases. Further experience has but confirmed the views therein expressed, hence a repetition of some of the important points. The following classification was found convenient:

I. Simple hemorrhage: 1. Acute posthemorrhagic anemia. 2. Chronic posthemorrhagic anemia.

II. Pathologic hemorrhage: 1. Hæmophilia. 2. Purpuric group. (a) Hemorrhagica neonatorum. (b) Symptomatic and idiopathic purpura.

III. Secondary hemorrhagic disease, such as complicates icterus, sepsis, nephritis, dysentery, blood diseases, etc.

---

\* Read before the New York Surgical Society, November 22, 1922.

I. SIMPLE HEMORRHAGE. 1. *Acute Posthemorrhagic Anemia*.—This may follow trauma, labor, operation or any accidental cause, or may be a complication of gastric or duodenal ulcer, ectopic pregnancy, typhoid fever, etc. In this form of acute anemia, if the bleeding point or area can be controlled, the introduction of new blood into the system will prove specific. No other measure will so promptly resuscitate a dying patient. In fact it is the only efficient remedy if bleeding has gone beyond a certain degree. When the source of the hemorrhage is not accessible without operation, as in gastric or duodenal ulcer, or typhoid fever, judgment as to the proper time to administer blood is required. As a rule it is better to wait until bleeding has stopped. If, however, the anemia is severe enough to endanger the life of the patient, even though active bleeding is still going on, it is safer to transfuse a moderate amount of blood. The hæmostatic action of new blood is often prompt and the stimulating effect is always gratifying. In the profuse bleeding, which, for example, may accompany the rupture of an ectopic pregnancy, transfusion and operation can be performed simultaneously. Transfusion is indicated in any case of acute anemia where the systolic blood-pressure is below 90 and where reaction does not follow the use of the simpler measures for combating shock, such as infusion, external heat, stimulation, etc. Generally speaking a single large transfusion meets every indication, but if necessary the operation can be repeated.

2. *Chronic Posthemorrhagic Anemia*.—This may result from repeated small losses of blood, as in persistent epistaxis, gastric or intestinal ulceration, bleeding hemorrhoids, metrorrhagia, etc. The losses of small or moderate amounts of blood cause, first, over-stimulation, and later exhaustion of the hæmatopoietic system. The ability to manufacture new blood seems for a time arrested, even though the source of the hemorrhage be controlled or removed. In this condition no other remedy will compare with the whole blood in producing hæmatopoietic stimulation. Serial transfusions of moderate amounts of blood meet the indications here.

II. PATHOLOGIC HEMORRHAGE. 1. *Hæmophilia*.—Without any discussion of this peculiar hereditary and congenital disease, it is now quite generally conceded that in whole unmodified blood we have the best remedy for checking the bleeding, which sometimes resists all other measures. While the disease itself is not cured, the alarming and dangerous symptom is controlled and immunity against excessive bleeding is established for a variable period. Prophylactic injections of blood should be given from time to time, for as age advances the bleeding tendency diminishes and may cease altogether at maturity.

2. *Purpuric Group*. (a) *Hemorrhagica Neonatorum*.—This disease probably belongs to the purpuric group and is due to some underlying toxæmia. It formerly was regarded as a most serious affection, with a bad prognosis, and with a mortality ranging as high as from 50 to 75 per cent. Blood therapy has given brilliant results and has reduced the mortality to 5 or 10 per cent.

Transfusion is the method of choice for correcting this dyscrasia and will often prove life-saving after the failure of all other measures.

(b) *Symptomatic and Idiopathic Purpura*.—Purpura is usually due to some form of bacterial, metabolic or chemical toxæmia. In the symptomatic variety, the disease tends towards spontaneous and permanent recovery, if the underlying etiologic factor can be determined and eliminated. Idiopathic purpura—so called constitutional purpura or essential thrombopeny—is probably a clinical entity. Prolonged bleeding time, normal coagulation time, marked diminution in the platelet count and lack of capillary resistance (Hess' test) are the essential features of the disease. Transfusion will often check the bleeding of purpura hæmorrhagica, but it by no means has the specific hæmostatic action seen in hæmophilia and hæmorrhagica neonatorum. By repeating the transfusion in an obstinate case, whenever bleeding is active or anemia acute, one can often save the life of the patient. In certain instances of constitutional purpura, however, in spite of the fact that the blood loss is repeatedly replenished by transfusion, the patient grows progressively worse and eventually dies of some obscure toxæmia. In one case, in spite of eight transfusions and a splenectomy (at the suggestion of Dr. Alfred Hess) the patient finally succumbed to cerebral hæmorrhage.

III. SECONDARY HEMORRHAGIC DISEASE.—It is probable that all types of pathologic hæmorrhage, except hæmophilia and possibly constitution purpura, belong to the class of "secondary hæmorrhagic disease." This term is used merely for convenience to indicate the variety of hæmorrhage seen in icterus, sepsis, nephritis, blood diseases, etc. In the management of this form of bleeding, it is imperative that the original disease be given appropriate treatment. For the prevention of hæmorrhage and for the control of bleeding, once it has started, blood transfusion is the most rational step.

To sum up, in acute hæmorrhage, whether simple or pathologic, and in chronic posthæmorrhagic anemia, we have in blood transfusion the best and at times the only efficient remedy. As a tissue transplant to replace lost blood, as a hæmostatic agent to check further bleeding, and as a stimulant to the hæmatopoietic system to manufacture new blood, the procedure is theoretically and practically sound.

Now consider the processes in which hæmorrhage plays no part. What are the indications for blood transfusion? Leaving out of consideration experimental work in blood therapy, the real indications may be grouped under the following divisions:

- (1) In selected cases of anemia.
- (2) In selected toxic and septic states.
- (3) In selected instances of general debility.

*Anemia*.—Following certain infectious diseases, such as pneumonia, influenza, the exanthemata, etc., there may develop a severe degree of simple, secondary anemia, which is slow to respond to the usual treatment. Blood transfusion is not indicated, and is of little value, during the acute disease, but after the infectious process has exhausted itself, and incidentally left the patient exhausted too, transfusion is of benefit in awakening the appetite,

improving digestion, etc., but its greatest value is in its stimulating influence on the sluggish blood-making system. It will do little good, for example, to use blood therapy to combat the grave anæmia of malaria or uncinariasis, if the malarial organism is still present in the blood or the parasites or ova are still present in the intestinal tract, but after their complete eradication transfusion will shorten convalescence and greatly hasten recovery. The same is true of the hæmolytic type of anemia which sometimes occurs during the puerperium, caused by poisons formed in the placenta. The impression made on the anemia by transfusion may be disappointing during the puerperal state, but its action is prompt and gratifying after the uterus is emptied. The same may be said of practically all of the simple, secondary anemias, which are slow to yield to the usual hygienic, dietetic and medicinal plans of treatment, that, if the cause can be determined and removed, then recovery can be materially hastened by transfusion.

(2) *Pernicious Anemia*.—When the blood picture is such that the anemia can be placed in the “pernicious” group, we have to deal with a “malignant disease of the blood,” an incurable affection. It often represents a late, sometimes the terminal stage, of a low-grade, insidious form of sepsis. It is obvious that attempts should be made to eradicate all foci of infection, which might have a causative bearing on the anemia. While transfusion never cures, it is our best remedy for this disease. Splenectomy is indicated in selected cases. Hitzrot<sup>7</sup> has given sound advice on the selection of cases for splenectomy and his views should be given serious consideration.

(3) *Leukæmia*.—Transfusion makes but little impression on even the chronic types of leukæmia and, in my experience, is absolutely useless in the acute lymphatic variety.

*In Toxæmia and Septicæmia*.—Transfusion has been tried in the acute stage of certain infectious diseases with the idea that healthy blood might possess antitoxic properties. The results, for the most part, have proved disappointing. Except for its transient stimulating and strengthening action, it seems to have little effect. It would appear theoretically logical and practically correct to use the blood of immune donors to combat the infection of such diseases as typhoid fever, scarlet fever, measles, etc., where recovery from the attack gives lasting immunity, but the fact that the majority of the victims of these diseases recover under ordinary treatment, that it is difficult to secure proper donors at the right time, and further that the immunizing factors do not reside solely in blood, but in the body cells as well, have prevented any systematic studies in this direction. The effect of transfusion, when used to overcome the acute intoxications of diabetes, uremia, hyperthyroidism, etc., is practically negative. Crile advocates transfusion in acute hyperthyroidism in order to increase “internal respiration” and thereby to combat “intracellular acidosis.” Can such a theory be sustained? In illuminating gas poisoning transfusion—preceded by blood letting—is a rational procedure and has given good results. Efforts at treating opium and bichloride of mercury

poisoning along the same lines have, to our knowledge, resulted in failure. What else could be expected?

Many attempts, on my own part, to influence the course of acute septicæmia and bacteræmia by blood transfusion have proved futile. When the infection reaches a subacute or chronic stage, especially if anemia is a prominent symptom, then will the strengthening and stimulating effect of new blood make its influence felt. Mere anemia and exhaustion, as has been pointed out by Ottenberg, may be all that prevent the overcoming of an infection. It goes without saying that the original focus of infection should be given appropriate treatment and, if possible, eradicated if we are to get the best results.

*General Debility.*—Transfusion, as a pre-operative measure, has enabled many an anemic, debilitated and doubtful surgical risk to go safely through the ordeal of an operation. It has often tided such a patient over that critical period immediately following a trying operation. It has on occasion, in infantile pyloric stenosis, after operation, proved life saving, by supplying fluid, and nutrient fluid at that, to the desiccated and starved-out tissues. It has been an aid, when judiciously employed, in overcoming the anemia and general weakness, in certain protracted diseases or painful injuries, where suffering and prolonged confinement rendered the outcome slow or doubtful.

*The Best Method of Blood Transfusion.*—What is the best method of blood transfusion? Now that it has been demonstrated by clinical and biologic tests that unmodified blood is superior to citrated blood, what is the best method of transfusing unmodified blood? The answer is not difficult, that method which most closely approaches vessel to vessel anastomosis, without the obvious inconveniences, uncertainties and disadvantages of the latter. The syringe-cannula or the syringe-stopcock-cannula methods closely approach direct transfusion and (1) can be employed with a minimum of inconvenience and pain to donor and patient; (2) can be repeated at will; (3) the transfused blood can be given in any desired amount, and can be measured accurately; (4) and the blood is outside the body a minimum of time and is transferred in its natural state, thereby lessening the chances of unpleasant reactions. The operation is relatively easy but it is not as simple as is generally thought. Practice and the minutest attention to details are necessary in order to carry out the procedure successfully.

Blood transfusion is a valuable expedient when employed with proper discrimination as to indications. Except in hemorrhage or the hemorrhagic diseases, however, it has but little curative effect, but as a palliative resource its powers for good are far-reaching.

#### BIBLIOGRAPHY

- <sup>1</sup> Unger, L. J.: Precautions Necessary in the Selection of a Donor for Blood Transfusion, J. A. M. A., Jan. 1st, 1921, vol. lxxvi, p. 9.
- <sup>2</sup> Unger, L. J.: Deleterious Effect of Sodium Citrate Employed in Blood Transfusion, J. A. M. A., Jan. 31st, 1921, vol. lxxvii, p. 2107.



## BLOOD TRANSFUSION

- Drinker, C. K., and Brittingham, H. H.: Transfusion Reactions, Archives of Internal Medicine, Feb., 1919, vol. xxiii, p. 133.
- Bernheim, B. M.: Whole Blood Transfusion and Citrated Blood Transfusion, Possible Differentiation of Cases. J. A. M. A., July 23rd, 1921, vol. lxxvii, p. 275.
- Horsley, J. Shelton, Vaughn, W. T., and Dodson, A. J.: Direct Transfusion of Blood, Archives of Surgery, September, 1922, vol. v, p. 301.
- Peterson, Edward W.: Results from Blood Transfusion in the Treatment of Severe Posthemorrhagic Anemia and the Hemorrhagic Diseases, J. A. M. A., Apr., 1916, vol. xlii, p. 1291.
- Hitzrot, James Morley: The Surgical Treatment of Pernicious Anemia. ANNALS OF SURGERY, January, 1922, p. 31.

# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

*Stated Meeting Held November 8, 1922*

The President, DR. JOHN A. HARTWELL, in the Chair

### STAB WOUND OF SPLEEN

DR. DEWITT STETTEN presented a young man, sixteen years of age. At about five-thirty P.M. on May 3, 1922, a comrade stabbed him in the left side with a hunting knife. A small wound was made that was not regarded as serious by the doctor who first saw him and who gave him emergency treatment. He walked home, took dinner, and at about eight P.M. began to have some abdominal discomfort which gradually increased, until about one A.M., May 4th, when the family physician was sent for. He recognized at once that there was some serious abdominal injury and sent the patient to the Lenox Hill Hospital. His temperature had risen to  $103.4^{\circ}$ , his pulse was 130, and his respirations 60. The entire abdomen presented a board-like rigidity and was exquisitely sensitive. There was a leucocytosis of 18,000, with 80 per cent. polymorphonuclears. A small, insignificant stab-wound was noted in the mid-axillary line on the left side between the ninth and tenth ribs. The examination of the chest was negative. An immediate laparotomy was performed. An oblique incision was made, parallel to the left costal arch. On entering the abdominal cavity, a large quantity of fresh and clotted blood was found which was swabbed and suctioned out. The spleen was at once examined and on the external surface near the posterior border was found a small stab-wound, about one-half inch in length and about one-quarter inch deep, which was bleeding profusely. This wound was closed by several simple, interrupted silk sutures, which seemed to control the hemorrhage. As an extra precaution, a narrow gauze tampon was led down to the injured area and the abdominal wound was closed in the usual fashion. The patient made an entirely uneventful recovery.

### ABSCESS OF THE LUNG

DR. NATHAN W. GREEN presented a woman, aged twenty-eight, who was admitted to the medical service of St. Luke's Hospital on March 30, 1922, and was referred shortly after to the surgical service, Division A.

The history was as follows: Three weeks ago the patient underwent a tonsillectomy. One week after there began a sharp stabbing pain in the right axilla and at the same time cough and expectoration of considerable black material. The cough continued getting worse daily. Profuse expectoration of grayish-green material of foul taste and bad odor was now present.

## ABSCESS OF THE LUNG

*Physical Examination.*—Normal except that she had a grayish-green sputum of foul odor and the right lung presented harsh vesicular breath and voice sounds, impaired resonance, dullness with diminished breath sounds and voice of bronchial quality. Moist râles were found during inspiration below the clavicle anteriorly and in the axilla. Röntgenograms taken by Dr. L. T. LeWald showed the presence of a lung abscess with a fluid level.

She was operated upon for drainage of this lung abscess by the two-stage procedure. The first stage was done on April 6, 1922, under local anaesthesia, making an incision in the axilla and removing three inches of the second rib. The costal pleura was exposed and the wound packed with iodoform gauze. The second stage was done on April 15, 1922, the packing of the previous operation was removed and a large exploring needle was passed in every direction and no pus was found. The wound was packed with iodoform gauze, packing down into lung tissue that had been penetrated by finger (blunt) dissection.

On April 26, 1922, the iodoform packing was removed and it was found that the abscess had opened from packing the area as was evidenced by the characteristic smell of the pus and by the blowing of air.

On May 7, 1922, she was discharged with a small granulating area and a bronchial fistula with slight discharge. She reported for dressings occasionally and was healed the latter part of May. This patient was married in June and has been well ever since the closure of her bronchial fistula.

DOCTOR GREEN presented a second case of lung abscess, in the person of a man, aged thirty-seven, who was admitted to the surgical service of the First Division, St. Luke's Hospital, January 2, 1922.

The history was as follows: Cough and sputum. Duration three months. Three months previously he was operated upon for gall-stones. His sputum became yellow, frothy and of a very foul odor. The pain radiated to the right chest anteriorly just below the acromion end of the clavicle. The pain and cough were progressively worse.

He was a fairly well-developed man appearing chronically ill, who coughed almost continually and expectorated a very foul-smelling sputum. Breath sounds harsh. Right chest dull with diminished breath sounds at lower angle of scapula posteriorly. Few râles heard about this locality. Anteriorly no change in percussion noted. Many fine crepitant râles were heard at the end of inspiration beneath the right clavicle and down about two ribs. Fremitus normal anteriorly, absent over scapula area posteriorly.

His Wassermann reaction was negative. Röntgenograms taken by Dr. L. T. DeWald showed a typical lung abscess with a fluid level.

He was operated upon by the two-stage method for drainage of the abscess. The first stage was done January 10, 1922; a vertical incision was made over the fifth and sixth ribs along the medial border of the scapula, and the ribs were removed for about three inches. The intercostal muscle between the ribs was ligated and removed. There was a

hard point palpable 4 cm. in diameter at the midpoint of the incision. There were no pleural adhesions and the parietal pleura was accidentally opened beneath the sixth rib. The wound was packed with plain gauze for the purpose of forming adhesions preparatory to a second operation. The second stage was done January 21, 1922; the wound was explored and dense adhesions were found about the site of the abscess. The abscess was palpated and explored with a needle; a small amount of pus was withdrawn, the cautery was inserted and the presence of the cavity established by making an opening of  $2\frac{1}{2}$  cm. in diameter. When the patient coughed, pus exuded freely. A tube was inserted into the abscess and the wound packed with iodoform gauze about the tube. There was a subacute emphysema for a while.

The patient was discharged February 16, 1922, cured. He had gained thirty pounds in weight and has remained well since his leaving the hospital.

DOCTOR GREEN presented a third case of lung abscess in a man, aged fifty-three, who was admitted to the surgical service, First Division, St. Luke's Hospital, December 21, 1921.

The history was as follows: While working, the patient "felt something break in his right chest." This was followed almost immediately by bleeding. He coughed up a considerable amount of red blood and pus which had a very foul odor. For eleven months since then he has coughed daily and expectorated a great deal of foul-smelling sputum, especially on first awakening in the morning; often raising as much as a cupful at one time. He had had no septic condition as far as known. But about seventeen years previously was in a tuberculosis sanatorium. His sputum was always declared negative for tubercle bacilli.

He was a well-developed but poorly nourished man. There were a few moist râles, between the spine and the angle of the right scapula. The breath sounds were amphoric. The voice came through more clearly and there were a few large moist râles. There was clubbing of the fingers and toes.

Röntgenograms taken by Dr. L. T. LeWald showed a large cavity with a fluid level (Fig. 1).

He was operated upon by the two-stage method. The first being December 24, 1921. An incision was made over the seventh and eighth ribs at the angle of the scapula, removing three inches of the seventh and eighth ribs with the intercostal muscles. The pleura seemed to be adherent over most of the underlying area; so a needle was passed into the lung for a distance of about one and one-half inches and purulent material obtained. It was decided that to open the pleural cavity was safe in this instance; so a very small incision was made into the pleura but with a resulting inrush of air; consequently the wound was packed open with plain gauze packing and nothing further done at that time. The second stage of the operation was performed on December 31, 1921. The packing was removed and the abscess explored with a needle and greenish pus found. The abscess was opened with the cautery through a tract about 1 cm. wide and 3 cm. deep, the cautery being introduced into the centre of the abscess until pus came out. A soft rubber tube

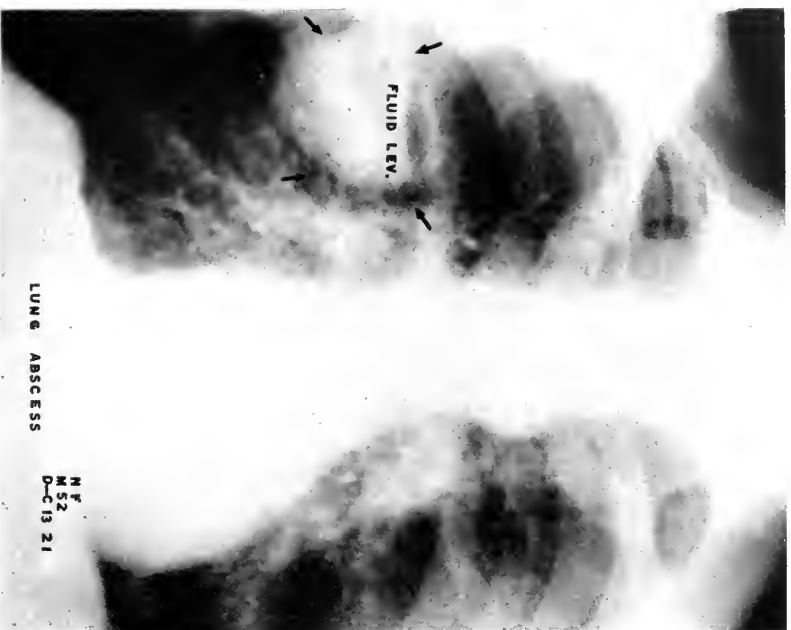


FIG. 1.—Case III. Lung abscess, eleven months duration. Showing fluid level. (Roentgenogram by Dr. L. T. LeWald.)

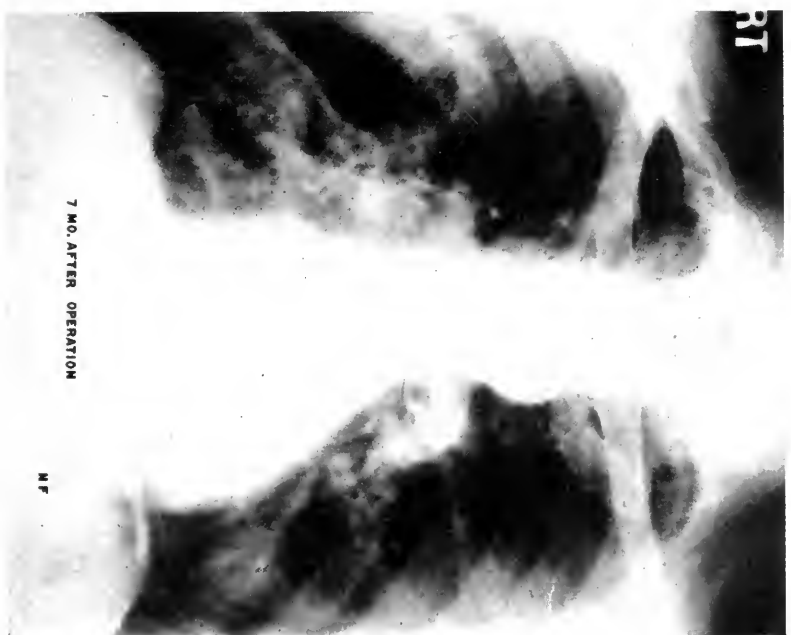


FIG. 2.—Case III. Appearance seven months after operation for lung abscess. Two stage method. (Roentgenogram by Dr. L. T. LeWald.)



## ABSCESS OF THE LUNG

was inserted into the abscess cavity and plain gauze packing was placed loosely about the tube.

The patient was discharged cured February 22, 1922. He subsequently gained thirty pounds and remained well until about a week ago, when he acquired a severe coryza and during the past week has lost some weight.

DR. HOWARD LILIENTHAL remarked that four weeks was rather a short time to observe a case before operating unless the abscess was progressing or the patient deteriorating. These cases should be carefully watched and artificial pneumothorax should be tried once at least. He had had one case recover, a short time ago, which was almost exactly like Doctor Green's post-tonsillectomy case, and she recovered after three refills of air. This procedure is of no use in old chronic cases. Doctor Lilienthal expressed his belief that a lateral view röntgenogram was very important before operation, as was examination with the fluoroscope with the patient's arms behind or over the head. A shadow view should be taken in three directions. One should know as much as possible about the location and size of the abscess before operation. The lateral view is taken too seldom. A word should be said regarding the cause of hemorrhage in these operations. It is due to a sloughing process which extends into the walls of the blood-vessels, and in the progressive cases many of these patients will die of hemorrhage of the lungs. Doctor Green had said he opened his way into these abscesses with the cautery, and Doctor Lilienthal hoped he would not continue to do so because he had had sad experience with the cautery. Anywhere between the third and fourth day, and even as far as the tenth day, a slough will fall out of a vessel that has been burned and the patient will bleed to death. He had a patient bleed to death in this way following attempted drainage in bronchiectasis. In trying to enlarge the abscess cavity bleeding started and was controlled with packing. One week afterward he bled again and preparations had been made to transfuse him, when he bled the third time and died. In these bronchiectatic cases there is progressive sloughing going on and on. The danger of opening an abscess of the lung by cautery is altogether disproportionate to its supposed advantages. By entering bluntly one can push the vessels aside with little danger of injuring an artery unless it is sloughing. Doctor Lilienthal said that he had recently used, in a number of cases, intratracheal suction when the patient was anesthetized. A small catheter was slipped down nearly to the bifurcation, an ordinary syringe was attached and was operated by an assistant every few minutes, and it was astonishing how much pus could be thus evacuated. Before operation, posture treatment was gone through to empty all the pockets. This method was an excellent one and should be used in every case.

DR. WILLY MEYER, referring to the early treatment of lung suppuration due to aspiration, said that recently in the bronchoscopic department of the Lenox Hill Hospital it had been possible to treat five cases *early* for beginning suppurative inflammation of the lung subsequent to aspiration, three after

tonsillectomy and two after aspiration of stomach contents, and these five cases had been cured. If this intrabronchial aspiration and treatment is done early, it will, he believes, become the method of choice rather than artificial compression of the lung with the help of gas. It stands to reason, that if that aspirated infectious material is removed as soon as possible, these patients will have a better chance to get well than if the material is left within the bronchial tree.

DR. HUGH AUCHINCLOSS said that some of the cases of lung abscess at the Presbyterian Hospital had done very well with open-air therapy on the roof without bronchoscopy or operation, but they had been deep-seated lesions near the root of the lung and were not very large cavities. He had been much impressed with the first case Doctor Green presented, which reminded him of a case of his own which had presented almost no physical signs; the abscess was in the same place and of about the same size, and the diagnosis was evidenced by the amount of sputum and X-ray. The two-stage operation was, in his opinion, the best procedure where the cavity could not be readily and accurately located or was not adherent to the chest wall. A marker that would show up clearly in the X-ray, such as a safety-pin, could be attached to the depths of the wound when packed at the first operation and aid in localizing for the second-stage procedure. The posture of the patient is very important, especially where a long bronchus communicates with the cavity. Local anæsthesia and readiness to change the patient quickly from one position to another on entering the cavity, or if there is excessive bleeding, are important.

DOCTOR GREEN, in closing said that the diagnosis in these cases had been made by the sputum and röntgenograms which had been worked up very carefully. Profile X-rays were taken in the first case. None had been shown to be tuberculous. Enthusiastic coöperation had been shown by Doctor LeWald of the X-ray Department. The case of the woman operated on for lung abscess, four weeks after tonsillectomy, was an early one, and he admitted the justice of Doctor Lilienthal's criticism. He was inclined to side with him and think she might have been given a longer time to see if she would recover without operation; but she was badly toxic and had a large abscess. So it seemed best and reasonable to go on and operate without waiting for a possible spontaneous but delayed recovery. Doctor Green recalled one case that he had turned back to the medical service to collapse with nitrogen in which the patient apparently recovered without further operation. One should select the cases. Some can be collapsed very well. But in going in surgically one sometimes finds adhesions and sometimes no adhesions, and this cannot be found out beforehand. If the lung has been collapsed with nitrogen, the adhesions may hold the area over the abscess out against the chest wall and prevent collapse of the very part one is seeking to influence. However, he believed many of these patients should if possible be given the benefit of the doubt. Whether the opening through the lung tissue should be made by cautery or by blunt dissection might be considered a moot question.



## RADICAL OPERATION FOR CHRONIC EMPYEMA

Doctor Green had had a fatal case by blunt dissection which matched Doctor Lilienthal's unhappy experience with the cautery. It was a matter of something beyond one's control. One could not see whether one were eroding a vessel or not by the cautery. He was careful, however, when he used the cautery to burn a big hole with a dull red tip, so the sloughing might be sufficiently deep to cause considerable thrombosis, so hoping to avoid hemorrhage after operation. In regard to Doctor Meyer's remarks about bronchoscopy, he believed Doctor Yankauer had been doing some remarkable work with it, although the speaker had not used it. He liked to use local anæsthesia as much as possible because it did not destroy the tracheal reflex. Should general anæsthesia be required, the posture treatment should by all means be given so that these patients might spill out what pus there might be in the cavity before the general anæsthesia. He remembered a case operated upon some years ago by the late Dr. Henry H. Janeway and himself, who, he thought, died of aspirating pus from one lung to the other during the operation. This patient never came out of the anæsthetic.

### ATYPICAL CHRONIC EMPYEMA

DR. WILLY MEYER presented two patients treated for a rather atypical and rare type of empyema. Both had been shown before in the course of the after-treatment. The first patient was a woman, twenty-eight years of age, who at the age of four had developed a post-pneumonia empyema which was treated with rib resection and drainage. A fistula persisted. Before 1917 she had been operated on four times; then she came under Doctor Meyer's care. The X-ray showed a long, sausage-shaped cavity parallel with the spine. Doctor Meyer removed the entire roof of the cavity after a skin muscle flap had been turned up, and then allowed the raised flap to heal on to the visceral pleura. There was no possibility of making decortication. The operation was done in three stages and the entire cavity was firmly healed and had been for about one year.

The second patient had inherited tuberculosis and had suffered from acute pneumonia with following empyema which developed in 1919. He came under Doctor Meyer's care with acute empyema. A piece of rib was resected and the lung was found collapsed with a large bronchial fistula. He was improved with Dakin's solution and it was then decided that as the lung could not possibly come to the chest, to bring the chest to the lung. A typical Schede operation was done under local anæsthesia and a large entrance was found into the lung. In two years the cavity has completely healed. There was for a while a persistent sinus. He was treated at the office with the Kromayer lamp. The quartz probe entered the canal for more than two inches. Total cicatrization and final complete healing resulted.

### RADICAL OPERATION FOR CHRONIC EMPYEMA

DR. CARL EGGERS presented a youth, sixteen years of age, who when about four years old had contracted measles, diphtheria and pneumonia, which were followed by empyema. A rib resection was done, and after

many months the empyema healed. In the next few years there were frequent recurrences, and as a result of these the patient remained an anæmic, undernourished child. He was subject to chills, cough and night sweats and was considered a tuberculous suspect, though no positive laboratory evidence was ever obtained.

In December, 1914, when he was eight years old, he was admitted to the Lenox Hill Hospital. A radical operation was done in two stages with an interval of one week. Portions of five ribs were removed and the lung decorticated. The wound healed after several months and has remained so. The question of preventing deformity was an important one, especially in view of the fact that the boy had only one leg, the other having been amputated in the mid-thigh following an automobile accident. This was accomplished by setting up exercises, and by wearing a corset during the growing period. The corset has been discarded only within the last few months. He is now a robust boy, able to engage in exercises and sports. His muscle function is normal. There is but very slight curvature of the spine.

DOCTOR EGGERS also presented a man, twenty-six years old, who at the age of fourteen developed an empyema, for which a rib resection was done. The wound never healed and the discharge continued profuse. There was no cough. In the following years several operations were done and pieces of different ribs removed, both in the posterior and anterior part of the chest.

When he came under observation in March, 1921, he was in good physical condition. The right chest was collapsed and moved but slightly. Four scars of former operations were present, two in the back, one in the axilla and one in front. Two of these were healed, while the other two were discharging thick pus. One fistula was situated between the eighth and ninth ribs posteriorly, the other between the fifth and sixth ribs anteriorly. X-ray pictures taken after bismuth injections of the fistulæ showed that they communicated with each other and that there were several tortuous channels extending in different directions, one of them into the extreme anterior end of the costo-phrenic sinus. Conservative treatment was without result and radical operation was therefore proposed. In May, 1921, the first operation was done at the Lenox Hill Hospital. It was very difficult on account of extensive fusion of ribs. A long curved incision was made connecting the two fistulæ, the muscles and skin were pushed upward and parts of six ribs and considerable cartilage then removed in order to gain access to the various ramifications of the cavity. A complete decortication was done, and the lung was found to be soft and mobile. A narrow fistula was found to extend upward to an unsuspected cavity. On account of the patient's condition it was not thought wise to do anything with that, however, except to enlarge the opening into it and to introduce Carrel tubes. The muscles and skin were closed and drainage instituted at the dependent part. The patient reacted well. The upper cavity was treated by the Carrel-Dakin method, but healing failed to take place. A second operation was therefore done September 26, 1921. At this time the lower wound was found well healed. The upper cavity was completely

extirpated, and the lung thoroughly mobilized. The wound healed completely in about three months and has remained so. The patient's general condition is very good, and owing to the removal of fused ribs and the liberation of his lung he feels much improved. There is no disturbance of muscle function. The patient is a butcher and is able to perform all work connected with that trade.

DOCTOR EGGERS also presented a woman, twenty-four years old, who first came under observation October 25, 1921, for a discharging thoracic fistula. She gave the following history: In July, 1919, she contracted pneumonia following childbirth. An empyema developed which was drained by rib resection. She was confined to the hospital for three months and was then transferred unhealed to a sanitarium for tuberculous patients, where she remained nine months. Since that time she has been treated at home with one irrigation daily. The patient stated that she had been well until the present illness. She ran a septic temperature while in the sanitarium. She had positive tuberculous sputum on only one occasion. Her child has remained well. She was admitted to the Lenox Hill Hospital for observation, where the following facts were noted: 1. There was no temperature or increased pulse. 2. There was no cough or expectoration. 3. Examination of the discharge from the sinus showed streptococci and tubercle bacilli. 4. The skin reaction was positive for tuberculosis. 5. A tuberculous focus was noted in the apex of the opposite lung. 6. Injection of the cavity with bismuth showed that it extended from the sinus in the bed of the ninth rib to the fifth rib.

Radical operation was decided on, and the patient was put on regular Carrel-Dakin treatment to clean up the cavity preparatory to operation.

*November 14, 1921.*—Operation. The object was to mobilize the chest wall and lung and to remove all diseased tissue. A long hook-like incision was made starting well up on the inner border of the scapula and encircling the fistula below. Portions of six ribs were removed, as well as the corresponding intercostal tissues. The entire outer wall of the cavity, which was one-half inch thick, was then removed. A large flat cavity was exposed which showed one recess extending upward and one inch into the anterior and posterior costo-phrenic sinus. The latter were completely shelled out, liberating the lung and diaphragm thoroughly at that point. The cavity was packed with iodoform gauze and the muscles and skin then closed.

The operation had been done under chloroform-oxygen anæsthesia. It was well borne. The convalescence was uneventful. The tampons were not disturbed until the second stage of the operation, two weeks later.

*November 26, 1921.*—Second stage. At this time the skin and muscle incisions were reopened, and the tampon removed. There was no retention of pus. In order to expose the recess extending upward, which was noted at the first operation, it was necessary to remove short pieces of two additional ribs, and two inches of the fourth and one inch of the third rib were therefore resected. All endeavor was now directed toward mobilizing the lung by a thorough dissection of the thick-

walled angle of pleural reflection. After this had been accomplished an incomplete decortication was done and the wound then closed. No attempt was made to inflate the lung. One iodoform and two plain gauze tampons were inserted.

The convalescence was uneventful. The tampons were removed one week after operation. The after-treatment consisted in injections of the cavity with iodoform oil and exposures to artificial sunlight. Though the cavity obliterated after a few months, a small superficial sinus proved quite obstinate and did not heal entirely until August, 1922.

The patient's general condition improved considerably. In September she weighed 101 pounds, which was more than she had ever weighed. There is no cough. She is able to do her own housework.

The tissue removed at both operations showed typical tuberculosis.

It is of interest to report that since the patient went home, apparently cured of her disease, her little boy became afflicted with tuberculosis of the spine, for which he is at present under treatment at the New York Hospital for Ruptured and Crippled.

DOCTOR EGGERS presented a fourth patient, a man twenty-four years old, who was admitted to the Public Health Hospital, New York, in November, 1920, with the following history: In September, 1917, while in the Navy, he fell from a height of forty feet and fractured the third and fourth ribs on the left side, lacerating the lung. Subcutaneous emphysema developed. The wound did not heal. Later the sinus was curetted without result. In May, 1918, the diagnosis of empyema was made and a portion of the sixth rib resected. In July, 1918, an intercostal incision was made in the eighth space. In April, 1919, a radical operation was done and portions of four ribs were resected. In June, 1919, a so-called Beck skin-sliding operation was performed after the resection of additional portions of ribs. He was again operated upon in August, 1919, at which time the denuded surface of lung was skin-grafted. The patient applied for treatment because the wound had never healed. He had to be dressed once or twice a day. A steel plate had to be worn for the protection of his lung and heart.

When he came under observation he presented a large open cavity in the left thorax in which the lung and pericardium were visible. The exposed surfaces of these organs were partly covered with skin grafts, and in the other areas showed sluggish ulcers. The rib margins extended slightly beyond the cavity below and on the sides and formed an overhanging roof above, so that the dome of the cavity was not easily accessible to treatment (Fig. 1). There was no cough, but the X-ray showed a tuberculous focus in the apex of the opposite lung. A radical operation was decided on in order to flatten out his chest, to remove all diseased tissue and to cover the exposed lung and pericardium with skin and, if possible, also with muscle.

*December 3, 1920.*—Operation. An incision was made along the margins of the cavity. The skin and muscles were pushed back. Portions of eight ribs were then removed in rapid succession. The lung was mobilized and completely decorticated, which was easier than had been anticipated. During this process a pocket was opened which con-



FIG. 1.—Result after Beck skin-sliding operation. Appearance of wound on admission to hospital.

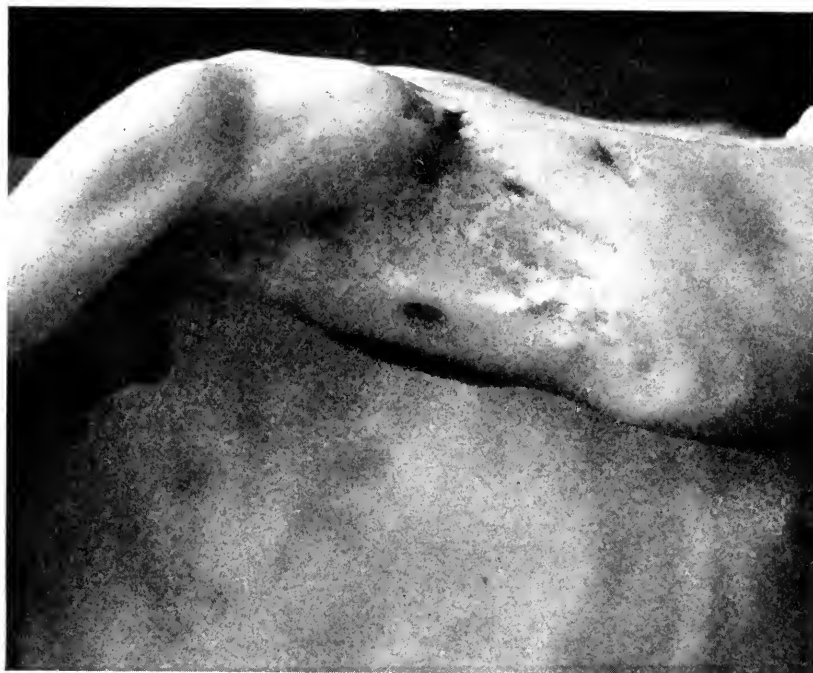
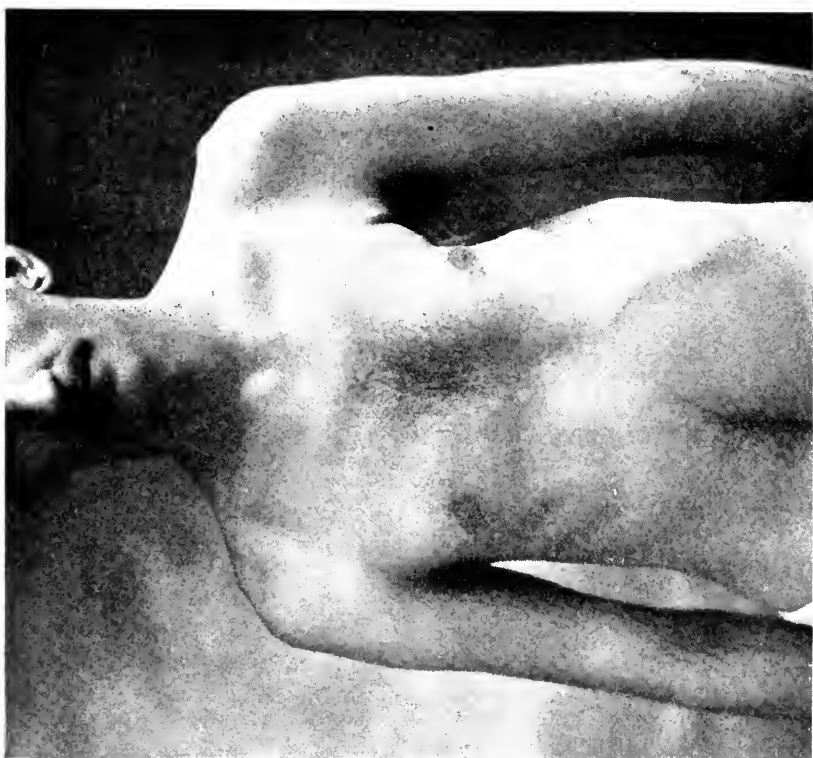


FIG. 2.—Final result. Exposed lung and pericardium completely covered with skin and partly with muscle.

## RADICAL OPERATION FOR CHRONIC EMPYEMA

tained about two ounces of typical rice bodies. It was completely extirpated. Very little intact muscle was found. Whatever there was present was utilized to best advantage for closure, and the skin flaps were then united. Two small tube-drains were placed at the lower end of the wound. There was very little reaction and the wound healed kindly, except for an infolding of the skin at the junction of flaps. In order to overcome this a second operation was performed on June 20, 1920. It was not of great magnitude. Except for an obstinate eczema of the skin flaps the convalescence was uneventful. The lung focus did not become acute after operation. The excised tissue proved to be typical tuberculosis.

The patient is now entirely well. He has no cough or other evidence of tuberculosis. His chest wall is firm. There is no secretion whatever. No protection for the chest wall is required (Fig. 2).

## RADICAL OPERATION FOR CHRONIC EMPYEMA

DR. CARL EGGERS read a paper with the above title, for which see vol. lxxvii, p. 327.

DR. HOWARD LILIENTHAL said there was only one thing in which he differed from Doctor Eggers and that was in the extent of his resections of rib. He thought four inches from six or seven ribs was more than was necessary. He had started in 1914, and had practiced with great success ever since, the use of the incision which Torek makes for intrapleural œsophagus operations, which is an intercostal incision in the seventh space. Then, if the cavity is toward the back, he cuts the ribs posteriorly above the interspace, but does not resect, puts in a rib spreader, and gets a perfect view of the inside of the chest. Every part can be seen from the apex down to the base. He clears off the exudate from the visceral part of the pleura and then makes drainage by enlarging the original fistula and making it large enough to get to the bottom of the chest. He closes it in the same way that Doctor Eggers does, but he thinks he avoids the deformity that follows too large rib resection. Of course, careful measurement will always show a smaller capacity on the sick side. With that slight exception, Doctor Lilienthal expressed himself in perfect accord with Doctor Eggers in the principles and practice of this important subject.

DR. NATHAN W. GREEN remarked that there were one or two points for reflection, and one was the difference between chronic empyema and chronic open pneumothorax. He thought one slid into the other, but that there seemed to be a difference. He was interested to learn that he used bismuth fearlessly in his injections into these cavities. He knew there were those who feared to use it. Doctor Eggers had mentioned the time as a factor between the first and second operations. Time undoubtedly is a factor in closing these cavities, for if one waits long enough a large part of the open pneumothorax cavity formed at the first operation will be found to be obliterated in certain cases, either by the action of pressure by coughing, etc., or by a progressive growing together of the parietal and pleural surfaces around the periphery where these two surfaces form a circle of contact.

Another point was that the first operation might be a valuable index to the patient's power of resistance to further procedure. If a patient did not stand well a small operation at first, one would know that he would offer little resistance to a larger operation later, and *vice versa*. Doing the operation in stages and observing the results between times is important in getting these patients through alive.

DR. H. H. M. LYLE said that as a matter of record he would like to confirm Doctor Eggers' figures. He was a member of a commission appointed by the Surgeon General of the Army to inspect Fox Hills Hospital. The commission at that time inspected Doctor Eggers' report in mortality figures and found them much more favorable than the figures of similar class of cases in the large hospitals in New York.

DR. WILLY MEYER said that Doctor Eggers had spoken of the possibility of healing an old cavity by means of improved thorough drainage. The speaker had often seen this. Take a case of empyema fistula in the eighth intercostal space and a poorly drained cavity-remnant near the apex, found by radiography after injection of bismuth. If one excises the skin around the sinus, resects a piece of rib, covering the sinus upward, stage by stage, including the soft parts below the ribs, and drains the upper cavity, such a chronic empyema will usually heal. The point of decortication of the lung, according to Delorme, is very important. Years ago Doctor Meyer closed a chronic empyema cavity in a child by an intercostal incision plus decortication. In another case a Thiersch graft was placed in the bottom of a circumscribed old cavity with good result. Regarding regular bismuth injections in chronic empyema, they cannot do any good in the average case, and some patients get bismuth poisoning. But the injection of bismuth in chronic empyema for diagnostic purposes should be done in every instance. Regarding radical operation, it must never be forgotten that one is dealing with chronic septics who cannot stand very much. It is wiser to do the operation in stages and, if possible, under local anæsthesia. A preliminary transfusion of blood will help many patients, and so will intravenous injection of saline or Ringer on the operating table before the patient is moved back to his bed. Regarding the remark often made about a possible post-operative deformity, Doctor Meyer considered that of no special importance. Of course one should try and cure the patient with as little deformity as possible, but the main thing is to close the cavity.

DR. JOHN A. HARTWELL called attention to the different subdivisions of the entity known as chronic empyema. His classification presented by Doctor Eggers brings easily before those surgeons who do not see a large number of these cases the fact that each one must be treated according to the actual pathology present. It is very important that one should have a definite knowledge of the exact condition before undertaking the operation, and with this knowledge proceed along definite lines for its cure.

DOCTOR EGGERS agreed with Doctor Lilienthal about the desirability of reducing the after deformity, but explained that the cases he had shown were



## CALCULOUS CAST OF PROSTATE

not selected from the standpoint of lack of deformity, but because they had been very severe cases when they came to operation. Many of his cases had very little deformity and it was often possible to get such a result. He agreed with Doctor Lilienthal that not only deformity was to be considered, but the function of the lung, and he felt that if one removed short pieces of ribs and mobilized the lung to such a degree that it could expand to the limits of the thorax, the best results were attained. As far as operations for tuberculosis were concerned, he was still trying to feel his way. Regarding the bismuth, he had not used bismuth paste but bismuth oil which was originally used by Doctor Stevens of the empyema commission. The preparation consisted of bismuth subnitrate twenty parts, gum acacia three parts, and cotton-seed oil 100 parts. This oil can be injected easily. After it is allowed to run in, one plugs the opening, takes the picture and then removes the plug to get the oil out. After the oil has run out one takes another picture to show if there is pocketing. By using this method no case of poisoning has ever resulted.

## CALCULOUS CAST OF PROSTATE

DR. DEWITT STETTEN presented a cast of the prostate removed from a man sixty-eight years old. He was admitted to the Lenox Hill Hospital on May 8, 1922. He complained of a complete urinary retention of forty-eight hours' duration and gave a history of having had difficulty with urination and occasional attacks of retention during the past six months. Gonorrhœal infection was denied. The patient had a marked myocarditis, chronic emphysema and bronchitis. On rectal examination what corresponded to the prostate was felt as a rather larger than normal stony-hard mass of the shape of the prostate, which gave the sensation to the examining finger of a "bag of stones" under the rectal mucous membrane. On manipulation pus was expressed from the urethra. An immediate suprapubic cystotomy was performed under local anæsthesia and drainage instituted. No calculi were felt free in the bladder. An X-ray examination made after the cystotomy shows a large, dense irregularly oval shadow, with its longer diameter running transversely and with several lines of separation indicated. This shadow lies deep in the pelvis and in the median line (Fig. 1). It is obviously made by the calculous cast of the prostate which was felt per rectum. On May 31, 1922, the suprapubic wound was reopened, the mucous membrane over the prostatic region was transversely incised and the calculi were removed one by one from the bed of the prostate. The internal urethral orifice was completely surrounded by calculi. Five large irregularly shaped facettèd stones and seven or eight smaller fragments were extracted. When the prostatic bed was emptied of calculi it felt as if a perfectly clean and total prostatectomy had been performed, with no trace of the gland remaining. The prostate had evidently been completely replaced by the calculous formation. With some difficulty the fragments were fitted together as one does a jig-saw puzzle and glued in place. The result is a composite calculus roughly the shape and size of a somewhat enlarged prostate gland with the left lobe rather larger

than the right. On the upper anterior surface is a fairly deep funnel-shaped depression corresponding to the neck of the bladder and leading into the urethra through an opening under a rather irregular bridge formed by several smaller stones (Fig. 2). The calculus is a calcium-magnesium phosphate stone. Its weight is one and three-quarters ounces. Aside from some cystitis which cleared up under treatment, the patient's post-operative convalescence was quite uneventful and he was discharged from the hospital cured, June 29, 1922. Unfortunately, he was again taken ill the beginning of August and died in the Fordham Hospital on August 6, 1922. The cause of death was given as chronic cardiac renal disease.



FIG. 1.—Radiograph of calculous cast of prostate.



FIG. 2.—Photograph of restored calculus cast of prostate. Anterior view. Applicator passes under bridge of calculi through internal urethral orifice.

## CORRESPONDENCE

### ANEURISM OF THE THIGH

EDITOR ANNALS OF SURGERY:

Sir:

THE appended four case reports were read before the Southern Surgical Association at Memphis, Tenn., December, 1922. Two of them are of rather more interest than the others; one, because of its size, involving the whole middle third of the femoral artery. The other because the man had only one leg.

CASE I.—A colored miner, age thirty-five, noticed a mass in the popliteal space several months before admission to the hospital. One leg had been amputated through the thigh several years before as a result of an accident in the mines. He sought hospital treatment on account of pain from the tension of the growth. A pulsating mass the size of an English walnut was found in the popliteal space. Under ether with a tourniquet snugly applied the tumor was laid open and the openings at the upper and lower ends of the cavity were closed with No. 1 chromic catgut. As we had only one leg to deal with, great care was taken in closing the wound not to interfere with the collateral circulation that might be in the sack walls or in close proximity to it. The wound healed by primary union.

CASE II.—A colored miner, age forty, was referred to me for operation for a pulsating mass in the popliteal space. He had noticed a growth about two or three months before, but had not sought treatment until it became so painful that he was unable to work in the mines. Under ether the mass was laid open and two openings found; these were closed with catgut and the cavity obliterated as in the above case. He made a good recovery and has gone back to work as a coal digger.

CASE III.—A white man, twenty-nine years of age, had his left thigh crushed in the mines in June, 1918; no bones were broken. The bruises were chiefly in the middle of the thigh on the inner side. A small pulsating tumor appeared two or three weeks later. He walked on the leg for about a month when the mass began to enlarge very rapidly. He was admitted to the hospital September 26, 1918, with a large mass on the inner side of the left thigh which occupied about the middle third of the thigh over the course of the femoral artery. The growth had pulsed up to a few days before he came to the hospital. Under ether a tourniquet was applied and the tumor laid open throughout, some blood clots were turned out and the openings at each end, which were about five inches apart, were closed with chromic catgut. When the tourniquet was removed there was very little oozing. The sack was infolded and loosely sutured up with a small rubber drain down to the cavity. The circulation in the limb

## CORRESPONDENCE

was fairly good at the end of the operation and in a few days was practically normal. He made a good recovery and has a perfectly normal limb now.

CASE IV.—A young man was referred to me January 7, 1917, with the history of an accidental stab wound of the lower inner side of the thigh just below Hunter's canal. There had been some bleeding and some clots had been removed by slightly enlarging the skin wound. When I saw him the circulation in the thigh was good and the limb was only slightly enlarged. We decided that there was an injury of some muscular branches with bleeding into the tissues and put him to bed with the foot elevated. He improved and was asking to be sent home when on January 24th he began to suffer violently and the leg became considerably swollen at this point. The following day with a tourniquet around the upper part of his thigh a long incision was made along the course of the Sartorius muscle, which was dissected up; the heavy fascia beneath was very tense, and on being incised, a false aneurism was found about four inches long with a wound in the artery about half inch long. The wound in the artery was closed with six interrupted stitches of No. 1 chromic catgut. When the tourniquet was removed there was no bleeding. The Sartorius muscle was sutured down over the arterial suture line and the cavity obliterated with catgut. A tube drain was placed in the upper end of the wound and the rest of it was closed. The circulation was normal from the time of the operation. He was kept in bed for two weeks when he was allowed to go home on crutches. At the end of five months he was reported to be perfectly well and hard at work on his father's farm.

GASTON TORRANCE, M.D.,  
*Birmingham, Ala.*

### To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

### ANNALS of SURGERY

227-231 S. 6th Street  
Philadelphia, Penna.

# ANNALS *of* SURGERY

VOL. LXXVII

APRIL, 1923

No. 4

## LYMPHANGIOMA OF THE NECK

By JAMES E. THOMPSON, F.R.C.S., ENG. F.A.C.S.

AND

V. H. KEILLER, M.D.

OF GALVESTON, TEXAS

LYMPHANGIOMA of the neck is so rare a disease, that few surgeons have an opportunity to study directly more than a very small number of cases. Aside from the rarity of the condition, it presents peculiar pathological and anatomical features which are not yet fully understood, so that full report of all such tumors appears to be advisable. It is our privilege to be allowed to present a careful histological study of two cases of widely different clinical types which have been recently under our care in the John Sealy Hospital.

The neck is so well supplied with lymphatics that we should expect to find in this region true benign neoplasms composed of lymph-filled, endothelial-lined channels, which may or may not communicate with the normal regional lymphatics. These tumors possess the power of independent growth, and this growth occurs in the endothelial layer. Cell proliferation is slow. Nevertheless there may be a rapid filling of the channels with fluid, causing cystic dilatation, and thus giving a false impression of rapid enlargement of the tumor. Cell division is usually typical. Sometimes the mitoses become abnormal in frequency or configuration, and the suspicion of a malignant change (to endothelioma) is justified. As in many other benign tumors, such malignant changes may occur, either as a result of inflammation or traumatism, or without known cause.

Pathologically, lymphangiomas fall into three general types, the simple or capillary, cavernous and cystic. With the simple variety we are not especially concerned. In the neck, as elsewhere, they are small in size and superficial in position, so that their diagnosis and removal is a matter of little difficulty. The typical cavernous tumor may occur in the subcutaneous tissue or under the deep fascia. It consists of large anastomosing channels which may contain in their midst irregular masses of lymphocytes, aberrant lymph follicles and nodes, and quite frequently, many neoplastic blood-vessels which give it the appearance of a mixed hæmangio-lymphangioma. When such a tumor is situated deep in the neck it may cause serious errors in diagnosis and give rise to extreme difficulties during removal. The solid

tissue of the lymph-nodes may be grossly unrecognizable as such, and may arouse the suspicion of malignant disease, and the numerous blood-vessels may cause the operation to be protracted and bloody.

The cystic form of tumor is of even greater interest. It is still not properly understood, although the amount of attention recently given to it has

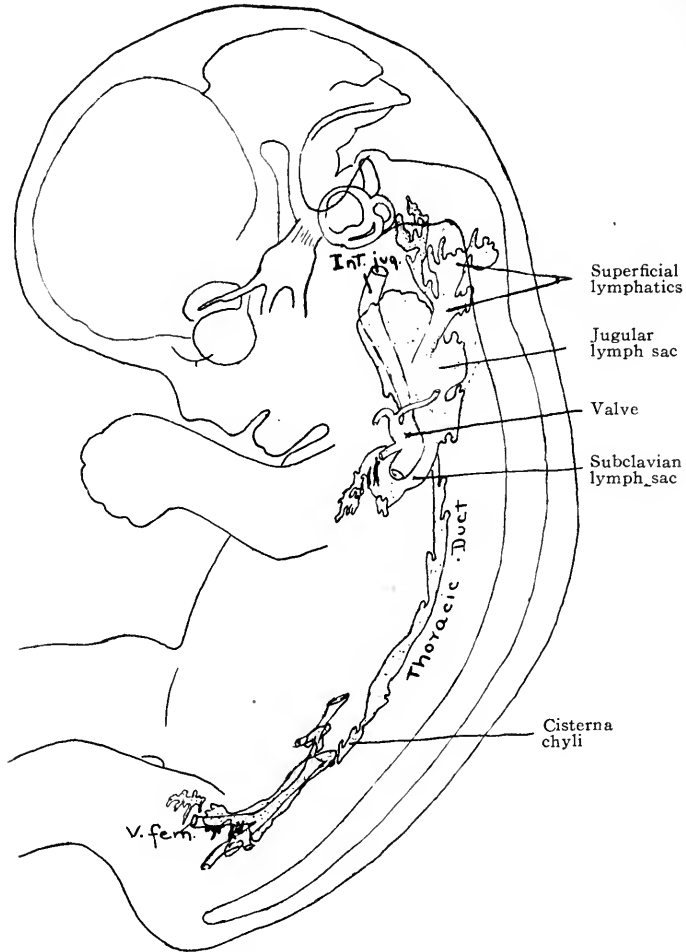


FIG. 1.—Diagram of jugular and subclavian sacs in 30 mm. human embryo. (After Sabin.)

cleared up many of the problems connected with it. In the neck frequently, in the axilla occasionally, more rarely in the groin, and in the retroperitoneal space, large cystic tumors are met with which may be unilocular or multilocular, which are filled with lymph and lined by endothelium. In many cases the collection of fluid occurs with surprising rapidity, so that one suspects an infective condition, yet the walls and the fluid contents of the tumor show no signs of inflammation. Again, having attained a certain size, the cyst may as suddenly cease to enlarge and remain for years at a standstill.



There is every reason to suppose that these hygromata are at the outset cavernous lymphangiomata, which become dilated with lymph either as a result of a change in the drainage, or an alteration in the function of their lining membrane. The sudden onset and rapidity of their growth is difficult to understand. It has been suggested that it indicates very active cell production, with an invasive power on the part of the endothelium; and the extension of these tumors into the axilla and mediastinum has been thought to corroborate this view. Against this there is very definite negative evidence,

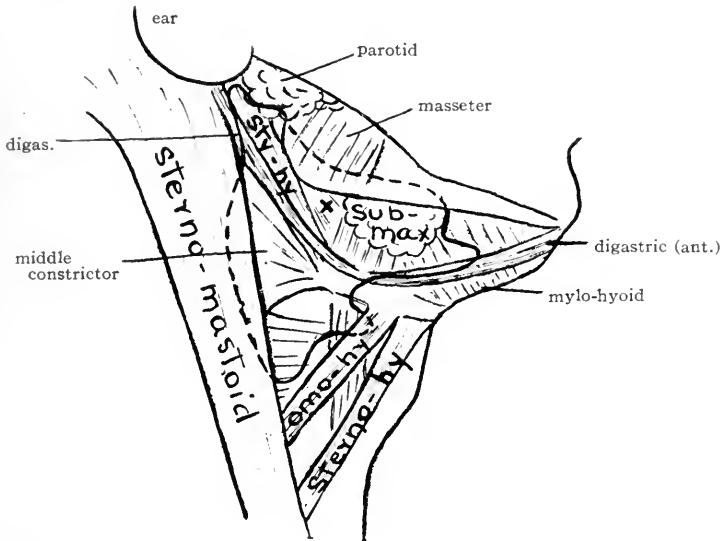


FIG. 2.—Case I. Anatomic relations of hæmangio-lymphangioma. At x the tumor was in contact with the superior constrictor of the pharynx.

in that the microscope shows the walls to be made up of small inactive lymphatics with adventitious fatty and fibrous tissue, and the lining endothelium of the cyst itself contains but few cells in the process of division. There is no active cell growth in a tissue which microscopically shows resting cells; and we cannot properly speak of any fluid collection as possessing the property of active growth no matter how rapidly it may enlarge. The "deep invasive power" is much better explained by the embryological origin of these tumors and the "rapid enlargement" on an hypothesis of altered cell function permitting increased lymph to collect.

Physiologists are still disinclined to accept a secretory function for endothelial cells, yet most pathologists and histologists incline to Heidenhain's contention that the lymph is in part a secretion, and not merely the result of osmosis and filtration. Few clinicians recalling the enormous amount of fluid in joint, pleural and peritoneal cavities (all endothelial lined) in infective or tumor conditions, will doubt that under pathological stimulation at any rate, endothelium does exercise a secretory function. That which lines the lymph-vessels does not usually secrete to such an extent that it attracts attention; the secretion, if it be such, is ordinarily diffused at once into the tissue

spaces and appears as tissue œdema. Yet endothelium of lymphatic vessels may, under certain physiological conditions, lose its permeability and prevent diffusion. The mesenteric lymphatics retain within their walls, under conditions of health, the chyle which they have taken up from the intestine. Pathologically, this endothelial impermeability may be greatly increased as in the infective conditions of serous cavities already mentioned. In order to explain the cyst formation in lymphangioma one must imagine an altered function with either increased production of fluid or decreased permeability of the walls, or both, since mere occlusion of the lymph passages draining the tumor would give rise to tissue œdema as well as to cyst formation, and this we do not find to be usually the case.

With reference to the invasive properties, the tendency of tumor growth is along the line of least resistance and an actively proliferating tumor in the neck should tend to grow outward and forward. This is precisely the direction taken by the cystic hygroma when it enlarges. It does not grow into the axilla or mediastinum. When it is found to extend from the root of the neck into these regions, it has actually originated in this situation, but has lain quiescent until cyst formation caused it to present as a visible swelling. This raises certain questions regarding the congenital origin of lymphangioma. Almost always where the history is clearly given, one finds that the tumor appeared at birth or so early that a congenital origin is probable. This is true to a certain extent of all lymphangiomata, but it is almost invariably true of those situated in the neck. This feature has led many pathologists to consider that an embryonic fault is the starting point of the condition; and in the peculiarities of the anatomic relations and the morphology of those found in the neck, there is much evidence to support this belief.

The lymphatic system begins at the end of the sixth week, with the formation of capillary nets of lymphangioma-blasts. These lymphatic anlagen appear in certain definite regions or "centres of initiation" which are marked by sac-like dilatations. From these centres new channels are formed by budding and canalization. The first pair of lymph sacs is situated in the neck between the primitive jugular and the subclavian veins, corresponding in position to the cervical lymph hearts of the amphibia; a second smaller pair occurs in connection with the iliac veins. The lymphatics of the trunk arise as smaller independent spaces in the mesenchyme which later become joined into large vessels. The lymph-vessels of the head, neck and arm are in the main outgrowths from the iliac sacs; those of the lower limb, pelvis and buttock, outgrowths from the iliac sacs. Yet it must be remembered that in these regions also, numerous independent angioblastic islands arise in the mesenchyme and become attached only secondarily to the jugular sac outgrowths (Huntington). Probably all growth in the older foetus and in the child after birth takes place as a result of the growth of already established channels. In considering tumors appearing some years after birth, one must bear in mind that the lymph-vessels are actively growing structures throughout the growth of the child, but since differentiation of endothelial cells is more

or less complete at birth, new channels probably arise only from those already laid down. In the consideration of tumors of all varieties arising in childhood, there is often too little attention given to the normal growth and continued development of cells occurring after birth. No one who has studied infant histology can feel that the end of intra-uterine life terminates cellular differentiation. It seems, therefore, to be going rather far afield to seek an origin for all lymphangiomata in "embryonic rests," even though one grasps the opportunity to explain on an embryologic basis certain peculiarities of

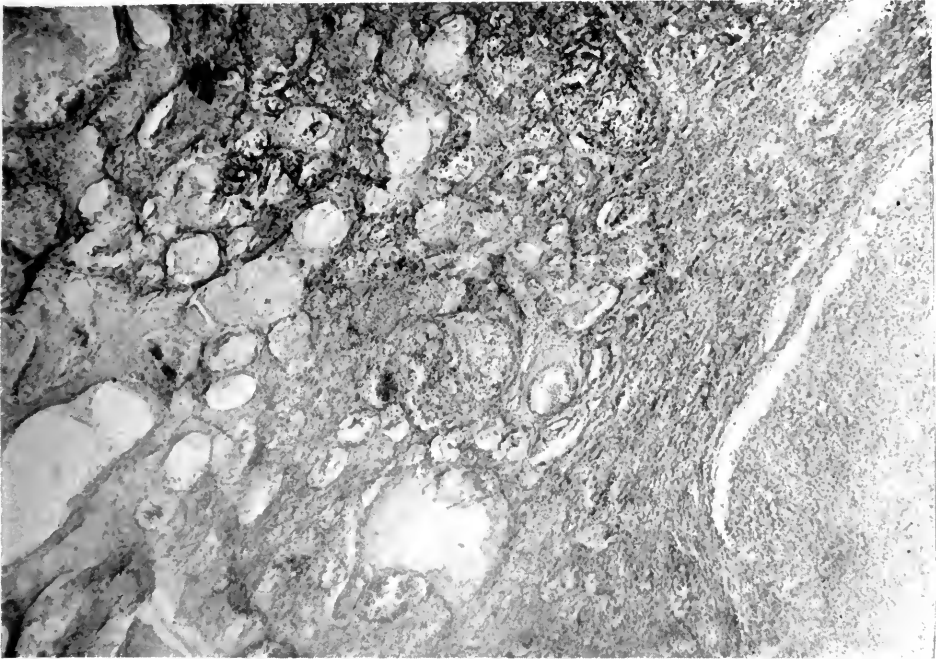


FIG. 3.—Case I. Hæmangio-lymphangioma of neck.

those most frequently met with in the cervical region. Dowd, in 1913, reporting four cases of cystic hygroma of the neck and reviewing ninety-one others, first definitely called attention to the relationship of the jugular lymph sac of certain adult fishes and of vertebrate embryos with the site, anatomic relations and cystic character of these growths. Since the publication of his article the jugular sac has been found to exist in the early human embryo, as well as in the usual "laboratory mammals," so that the embryonic origin of these tumors is established on a firm basis.

Before passing on, let us consider further the position of the jugular sac. It lies in the interval between the primitive common jugular vein and the subclavian, and early acquires an opening into both of these. Cephalad, its outgrowths extend along and lateral to the internal jugular and lie in intimate relation to the cervical nerves, as they emerge from the intervertebral foramina. Caudad, it is prolonged along the internal mammary vessels; while

laterally, it grows along the subclavian and axillary veins into the arm. In the posterior mediastinum it makes connection with the precaval lymphatics. Whether this growth is all the result of budding from the sac wall, or whether, as seems more accurately demonstrated, it is in part the result of a confluence of many independent islands, the result is, that one large lymph-space is formed, which is intimately associated with the great veins of the root of the neck and arm and lies in close relation with the cervical nerves and the prevertebral muscles. In the ordinary course of events, the sac



FIG. 4.—Hæmangio-lymphangioma of the neck.

becomes obliterated by the growth of reticular connective tissue and the development of lymph follicles and lymph-nodes. These arise from the endothelium lining the sac, at first lying within the lumina of the sac and its outgrowths, later becoming massed into definite organoid structures with independent vascular supply and capsule. A defect occurring at this stage would give rise to a condition of mingled lymphoid and lymphangiomatous tissue, such as is frequently found in the cavernous type of tumor. Our first case belongs to this type.

CASE I.—E. P., male, white, age thirteen months. History.—The baby is the first child of healthy parents. At birth he had a small tumor of the left side of the neck, apparently above or in line with the hyoid bone. This is said by the mother to have been the size of a hen egg, and to have moved freely under the skin. At the age of twelve days an operation was performed and the tumor

removed. The mother says that a small drain was placed in the anterior end of the incision, and that five days or so after the operation it began to drain pus, and continued to do so for some days. Finally the wound healed, leaving a tight scar, which the mother loosened by massage.

About the time that the baby was recovering from the operation, œdema of the face and lip of the same side began to appear, and within a few weeks the tumor of the neck came back and soon reached its present dimensions. This time it was of a diffuse character, and not "loose in the neck" as before. The baby has drooled saliva a great deal since the face became so much swollen. He suffers from severe attacks of tonsillitis whenever he gets the slightest cold.

*Examination.*—The child is fat, but rather pale and flabby. He appears to be in fair health. He appears to suffer no pain about the face or head.

*Local Examination.*—The right side of the face and neck is normal. The left side presents a diffuse swelling, suggestive of œdema, of the whole side of the face from the lower eyelid down; there is a little puffiness of the left side of the nose, and much swelling of the left side of the upper lip, causing a downward drooping of the angle of the mouth. There is some puffiness of the left lower lip, and general swelling of the whole cheek, causing projection into the mouth and externally; below, this swelling blends with a tumor of the upper part of the neck, so that the line of the mandible is obliterated. The cervical swelling is diffuse in character, and extends from the median line anteriorly to the angle of the mandible posteriorly; the anterior border of the sternomastoid cannot be felt. Below, the confines of the tumor are not easily made out, but it decreases rapidly and there is practically no swelling below the level of the cricoid cartilage. Over the whole swelling there is a bluish tint to the skin, and there are a number of rather large prominent veins.

A probable diagnosis of branchiogenetic cyst was made, the œdema being attributed to chronic inflammation as a result of infection and previous partial removal. The vascularity of the surface was not easily explained on this assumption and caused considerable anxiety.

*Operation.*—April 18, 1921. The submaxillary region was exposed by a curved incision similar to that usually employed for ligature of the lingual artery. The separation of the skin was rendered very difficult by the presence of scar tissue from the previous operation and by the vascularity of the mass and the adherence of skin to it. This was especially true of the posterior part of the tumor. The limits of the mass were very hard to define, as it spread round the normal structures and was everywhere obscured by scar tissue and great numbers of blood-vessels; its nature also made the differentiation of tumor from normal tissue very difficult. Bleeding was not very profuse, but there was a constant oozing which was almost impossible to control and which greatly increased the difficulties of the dissection. It was soon seen that the tumor was not a branchiogenetic cyst, but was of a lymphangiomatous nature. There were no large cavities, but many small cysts containing clear fluid. The diagram (Fig. 2) shows the anatomical relationships of the tumor. It extended upwards in the direction of the styloid process. The lower pole of the parotid gland was imbedded in it, and a small portion was removed with the tumor; in this region a lymphatic gland was recognized and removed. This was the only lymph-node seen in the dissection. Lower down the tumor extended under the anterior border of the sternomastoid muscle, from which it was separated with considerable difficulty. Anteriorly it was spread over the upper border of the anterior belly of the digastric and was inseparably blended with the superficial part of the submaxillary gland, which had to be removed. The deep part of the submaxillary gland was not involved and was left undisturbed.

In the submaxillary region the tumor extended upwards under cover of the



FIG. 5.—Case II. Cystic lymphangioma of neck.

lower border of the mandible, and behind the submaxillary gland it was in contact with the superior constrictor of the pharynx. Below the hyoid bone the tumor extended to the level of the anterior belly of the omohyoid and was wrapped around its upper margin. There was no sign of extension over the mandible on to the cheek, nor did the dissection explain the œdema. The wound was closed with silkworm gut sutures, with a gutter drain at the posterior extremity.

*Convalescence.*—The child left the table in fairly satisfactory condition, considering the length and character of the operation. Hypodermoclysis was used at once, and the baby reacted well. On the third day there was some swelling of the neck and wet dressings were used; a considerable quantity of thin milky discharge

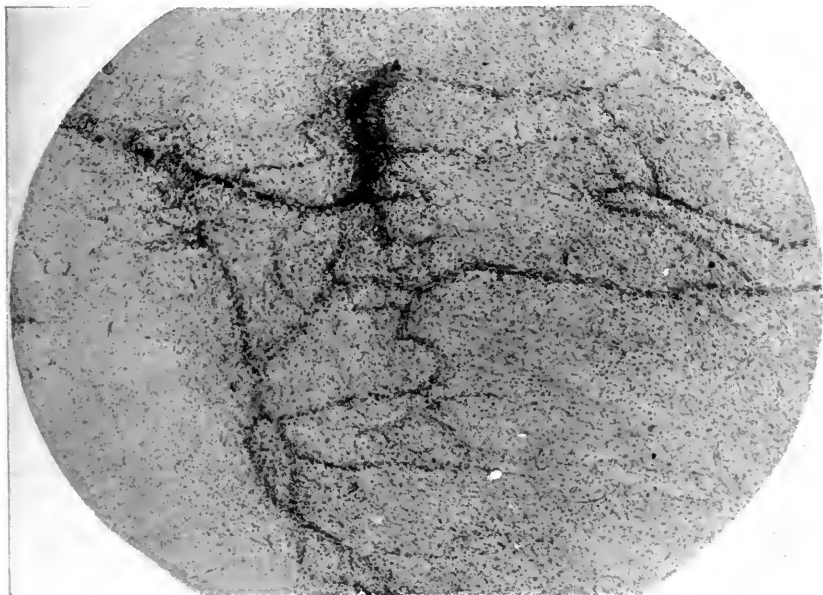


FIG. 6.—Cystic lymphangioma of the neck. Thin cyst wall mounted flat.

appeared the next day, and continued for some days after; there was slight fever for the first eight days, but this was never alarming. During the whole of the convalescence the baby drooled much saliva and it was difficult for him to swallow, on account of paralysis of the tongue from implication of the hypoglossal, which had been exposed in the dissection.

The baby was sent home on May 5th; the wound at this time was clean, and the paralysis of the tongue improving slowly. Six months later the paralysis of the tongue had disappeared; there was no recurrence in the neck, but there was still some œdema of the face and especially of the upper lip. It seems probable that there is a diffuse lymphangiomatous condition here also.

*Pathological Report.*—(See Figs. 3 and 4.) Grossly the tumor consists of a rather dense fibrous tissue full of small blood-vessels and small cysts varying from  $\frac{1}{2}$  cm. in diameter (in the preserved condition) to microscopic size. There are a few areas which appear to be embedded lymphatic glands and some of these are necrosed. Microscopically the mass consists of a few lymph follicles, more or less isolated from each other lying in a network of dilated and thickened lymph channels. There are many small blood-vessels giving parts of the tumor an appearance of hæmangioma. There is no suggestion of endothelioma nor of malignant proliferation of any kind. The portion of submaxillary gland sectioned is em-

bryonal in appearance and deficient in ducts. Pathological diagnosis: Lymphangioma, with an excess of blood-vessels.

In this case the tumor lay high in the neck, and there was no evidence that the main cavity of the jugular sac was at fault, since there was no cyst or tumor tissue below the omohyoid. Apparently the obliteration of the jugular sac had occurred in the normal manner, and the malformation occurred in its upper outgrowths. In our second case the condition is very different; the ingrowth of lymphoid tissue has not occurred; and the large potential space formed by the jugular sac, after remaining for a certain period undistended, and therefore unobserved, has suddenly dilated and become a matter of prime importance.

CASE II.—M. C., female, white, age five years. *History*.—Father died three years ago of Bright's disease. Mother living and well. One sister, aged three, in good health. The child had typhoid fever two years ago; whooping cough last spring; no sequelæ in either case.

*Present Trouble*.—The mother first noticed a tumor of the neck four weeks ago; since then it has grown steadily larger. One week ago the child first complained of pain and stiffness in the neck.

*Examination*.—The child was in excellent general health; all findings were negative except for the local lesion. The left side of the neck was occupied by a cystic swelling, covered by normal skin, which showed neither increased vascularity nor oedema. The tumor occupied the lower part of the posterior triangle and appeared to extend below the clavicle. It was very slightly tender on pressure, or when the head was moved. It was resilient, with a suggestion of fluctuation.

On admission to the hospital October 20, 1920, the temperature was 100.6°, but it dropped to normal during the night. On the following morning the cyst was aspirated and 10 c.c. of clear yellow fluid withdrawn. This confirmed the diagnosis of lymphatic cyst and operation was set for the following day. The temperature went to 100.6° again that afternoon, but there was no pain and the child did not appear to be ill.

*Operation*.—November 1, 1920. A transverse supraclavicular incision was made and the cyst was exposed. It was found to be multilocular. The superficial wall was very thin and in parts transparent, the deeper parts thicker. The mass extended below the clavicle into the axillary space, and lay in close contact with the upper cords of the brachial plexus. In order to facilitate the dissection about 30 c.c. of fluid were aspirated. This was clear, straw colored, and coagulated spontaneously. The dissection involved the free exposure of the internal jugular vein, the scalenus anterior, the anterior border of the trapezius muscle, and the phrenic nerve and upper cords of the brachial plexus. The wall of the cyst was applied to these structures, but did not infiltrate them. None were injured in the dissection, and it was possible to remove the entire wall of the cyst without injury to any of the surrounding nerves or vessels. A small drain was placed at the posterior end of the incision and the skin closed.

*Convalescence*.—The drain was removed on the second day and the stitches on the seventh day. Healing was by first intention, and the child left the hospital November 8, 1920, in excellent condition.

*Pathological Report*.—The specimen consists of a multilocular cyst ovoid in shape, 7 cm. by 5 cm. in diameter, having thin walls in which lie a few smaller cysts which do not communicate with the main cavity.

The fluid in the large cavity is yellow and coagulates spontaneously; that in some of the small cysts is colorless and does not coagulate even after fixation in



## LYMPHANGIOMA OF THE NECK

formalin. Microscopically the coagulum is acellular. The greater part of the cyst wall is very thin, transparent, and histologically (Fig. 6) consists of a delicate membrane of coarse and fine interlacing connective tissue, traversed by lymphatic vessels and capillary blood-vessels. The ordinary staining of this portion of the wall shows no lining endothelium, but a portion which was spread and stained with silver nitrate showed the typical pavement endothelial structure. A part of the cyst wall is thicker, about 3 mm., and sections of this show a definite endothelial lining. The wall (Fig. 7) is here composed of capillary lymphangiomatous spaces, and of spindle-shaped cells, fat and connective tissue. This region is full of capillary blood-vessels. Some of the areas here contain a few cells suggestive of

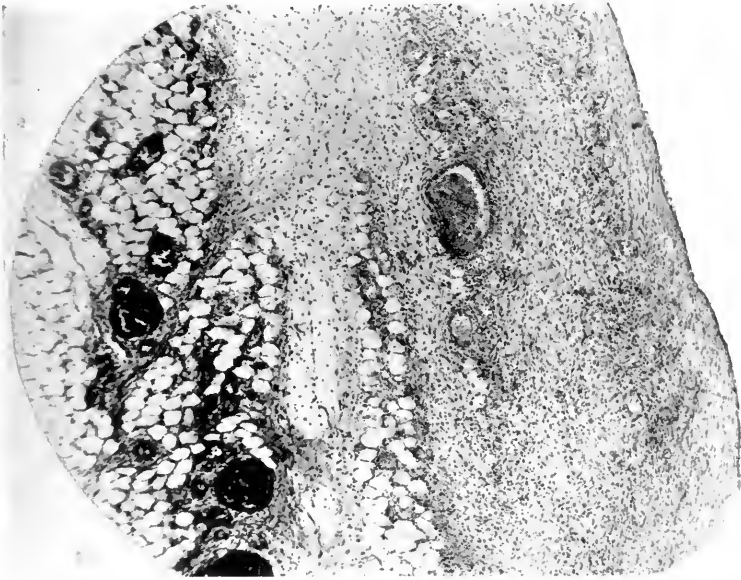


FIG. 7.—Case II. Cystic lymphangioma of neck. Section of cyst wall.

myxoma, but there is no evidence of any malignant change in any portion of the tissue.

*Diagnosis.*—Hygroma (multilocular lymphatic cyst) of the neck.

*After History.*—There has been no opportunity to examine the child recently, as she has left town. November, 1922, two years after the operation, her mother reported by letter that she was in excellent health; no sign of tumor.

This case illustrates excellently the quiescent interval and the sudden growth and cystic character of those tumors which arise as a result of the failure of obliteration of the jugular sac. The absence of lymph follicles and nodes in connection with it is further evidence that the essential fault is in the walls of the sac. So long as there was no abnormal increase of fluid within the space, no visible tumor appeared. Something, the exact nature of which we are unable to determine, possibly an infective condition or toxic absorption which was so mild that it left no positive signs of inflammation behind, caused an increased secretion of lymph and at the same time apparently a decreased drainage, and the tumor, enlarged along the lines of least resistance, showed itself as a visible swelling in the neck. In this particular case there was no

prolongation of the tumor into the axilla or mediastinum. This indicates that the axillary and thoracic embryonic outgrowths of the jugular sac had completed their development in the normal manner. In many of the cases reported, their outgrowths are still primitive and connected with the main sac; and the cystic tumor arising from them will be found to extend far down in these situations. Similarly separate axillary or mediastinal cysts may appear, with or without a cyst formed from the main jugular portion of the sac. It gives an erroneous idea of the origin and pathology of these hygromata to say that they "grow into" axilla or thorax. If this conception of their embryonic basis is correct, the anlagen from which they arise are at the start occupying these regions. Some new growth of lymphatic does occur, but it is rather the character than the amount of growth which is at fault. If the fault were merely the failure of the jugular tap to appear, then fluid should collect as soon as lymph begins to form, and tissue œdema should invariably follow. This is not the case, and it seems probable that, whatever the error in development, it is associated with an increased secretion on the part of the endothelial cells and a decreased permeability of the walls of the sac, so that escape of the excess fluid by diffusion into the surrounding tissue spaces is impossible.

Much further investigation of the absorptive properties of these cysts, and also more authoritative information regarding the physiology and pathology of lymph formation in varying conditions, are required to clear up these points. It is very necessary also that any cases of the kind, in which post-mortem examination can be made, should be most carefully dissected with a view to determining the exact condition and drainage of the regional lymphatics.

From the point of view of the surgeon, the chief matters of interest are:

1. These tumors, like most embryonal tumors, are primarily benign. Rapid growth does not indicate malignant transformation.
2. They may, and frequently do, contain a large hæmangiomatous element.
3. In all cases, and especially in the cystic forms, they are more deeply situated than a superficial inspection would lead one to suppose, and their deep relations and extensions follow certain definite lines, predetermined by their embryonic origin and not the result of infiltrative tumor growth.
4. Excision is the logical method of treatment.

#### BIBLIOGRAPHY

- <sup>1</sup> Dowd, C. N.: *ANNALS OF SURGERY*, vol. lviii, 1913, p. 112.
- <sup>2</sup> Downes, W. O.: *ANNALS OF SURGERY*, vol. lix, 1914, p. 753.
- <sup>3</sup> Huntington, Geo. S.: *Lymphatic Vessels of the Cat*, Memoirs Wister Institute, Philadelphia, 1911.
- <sup>4</sup> Keith, Herman: *Embryology and Morphology*.
- <sup>5</sup> Lewis, F. T.: *American Journal Anatomy*, vol. ix, 1909, p. 33.
- <sup>6</sup> Lyle: *ANNALS OF SURGERY*, vol. lx, 1914, p. 398.
- <sup>7</sup> Mathews: *ANNALS OF SURGERY*, vol. lix, 1914, p. 753.
- <sup>8</sup> Sabin, F. R.: *American Journal Anatomy*, vol. ix, 1909, p. 43.
- <sup>9</sup> Schmieden, V.: *Deuts. Zeitsch. für Chirurgie*, 1902.
- <sup>10</sup> Winslow, R.: *Surgery, Gynecology and Obstetrics*, vol. xxv, 1917, p. 428

## LIGATION OF INFERIOR THYROID ARTERY

BY JOSEPH L. DECOURCY, M.D.

OF CINCINNATI, OHIO

THE first indication of the reduction of thyrotoxicosis, when surgery is thought advisable, is ligation of one or both superior thyroid arteries. This together with rest for three or four months is frequently the only preparatory treatment necessary before thyroidectomy is justifiable. Occasionally, however, the improvement in these cases is not sufficient to warrant removal of the gland, and if we do so, we do it with a certain amount of risk, or attempt to reduce the risk by leaving the wound entirely open, or sometimes removing only part of the gland. This is the routine which we have used for a number of years, avoiding ligation of the inferior arteries because of an innate fear, founded upon theory, rather than clinical experience. We felt that the operation was of such a major nature that these patients could not withstand the ordeal. More recently, however, we have utilized this operation more and more with increasing gratifying results.

Ligation of all four thyroid arteries over a period of a few weeks must be condemned because of the dangers which it incurs. Theoretically, unless we have a *thyroidea ima* present we would naturally expect a gangrenous condition to follow. Tetany is also apt to occur, due to a removal of the blood supply to the parathyroid bodies. Clinically I have found a severe type of hyperthyrotoxicosis follow the fourth ligation, performed shortly after the initial ligations, although only a slight reaction followed the third ligation. Since then we have formulated the following routine:

Single or double superior ligation is performed at the first sitting—if single, the opposite side is usually ligated within the week following. The patient is then allowed to return home and is instructed to submit to almost an absolute rest. After three or four months the patient is again examined, and if thyroidectomy is still contra-indicated, in our opinion, we ligate one inferior thyroid artery. This is usually all which is necessary before performing a complete thyroidectomy. If, however, a month passes after the inferior ligation and the patient is still considered a bad risk for thyroidectomy, we then ligate the other inferior artery. This is performed from four to five months after the superior ligations and we feel that this is sufficient time for a slight collateral circulation to form about the superior poles and prevents disastrous results which may otherwise follow.

The results accruing from inferior ligation in severe cases are the following:

(1) If we consider a normal person as 100 per cent. and the improvement following a successful thyroidectomy as 90 per cent., I would say that a bilateral ligation of the superior arteries improves the patient 40 per cent., taken as an average, and ligation of all four arteries improves the patient 60

per cent., thereby lessening the margin of danger. (The above averages were formulated following a review of the basal metabolic rate in a post-operative study of a large number of cases.)

(2) In thyroidectomy of the severe cases of exophthalmic type which require ligation, hemorrhage is sometimes severe enough to narrow the safety

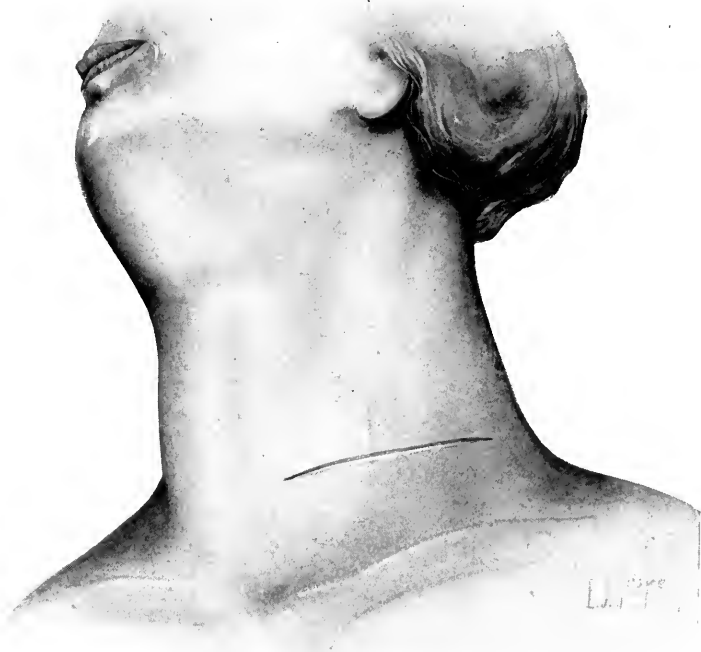


FIG. 1.—Position of transverse incision.

zone. With ligation of all four arteries, the hemorrhage is noticeably diminished and of little or no concern.

(3) Ligation of inferior arteries lessens more volume of blood to gland than superior ligation.

(4) Operation of inferior ligation is not difficult and is without danger if proper judgment is used as to time of operation.

(5) Operation can be performed in twice the time which it takes to ligate the superior artery—frequently being performed in five minutes and can be performed either with straight local or local combined with light nitrous oxide anaesthesia.

(6) It is rarely, if ever, necessary to allow wound to remain open following thyroidectomy preceded by three or four ligations.

(7) The incisions for inferior ligation can be made in same crease as incision for thyroidectomy and only one resulting scar remains.

## LIGATION OF INFERIOR THYROID ARTERY

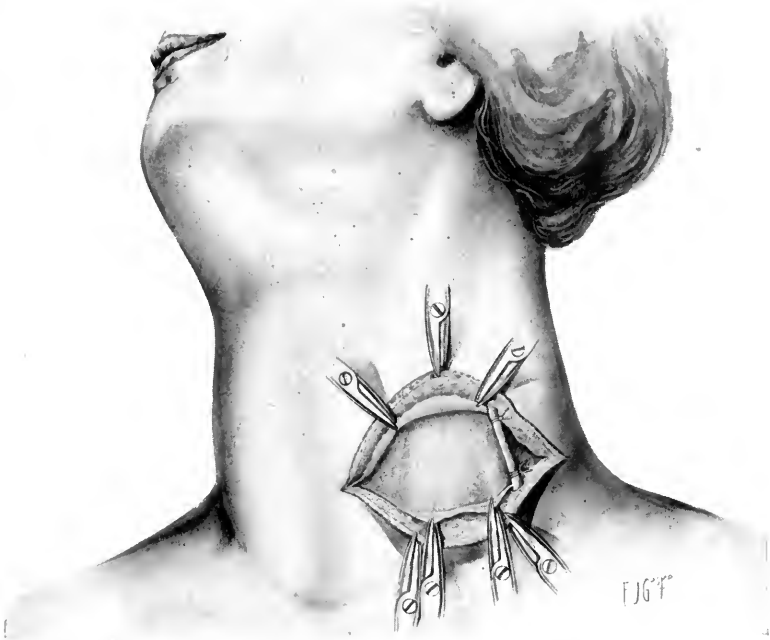


FIG. 2.—Showing division of deep fascia exposing the muscle fibres and the external jugular vein ligated.

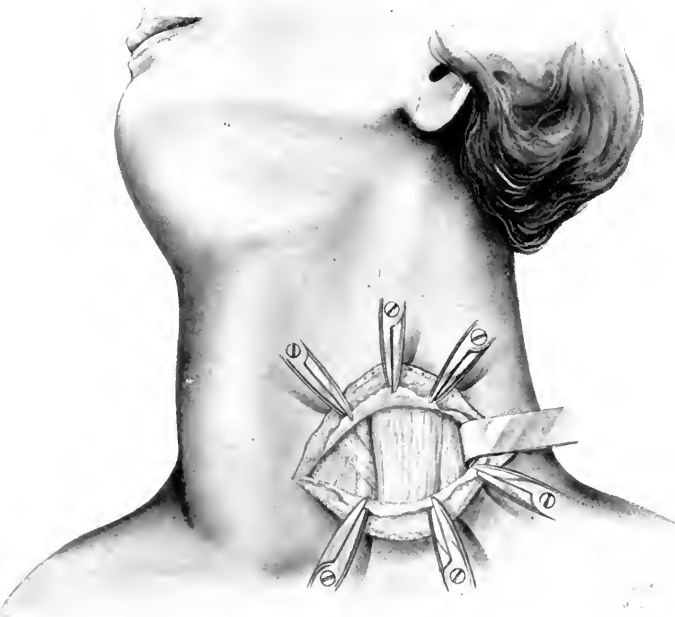


FIG. 3.—Showing appearance of sterno-mastoid muscle, before being retracted inwardly.

We have now performed inferior ligation sixty times with only one violent reaction, employing the following technic:

A transverse incision is made two finger breadths above the clavicle, with the centre overlying the posterior border of the sterno-cleido-mastoid muscle (Fig. 1). The incision is carried down through the deep fascia until the muscle fibres are exposed (Figs. 2 and 3). (It is sometimes necessary to ligate and divide the external jugular vein at the posterior portion of the wound.) The sterno-mastoid muscle is drawn inwardly and the division noted between the thyroid gland and the carotid sheath. A hæmostat is then placed between the thyroid gland and the carotid sheath, hugging the thyroid capsule

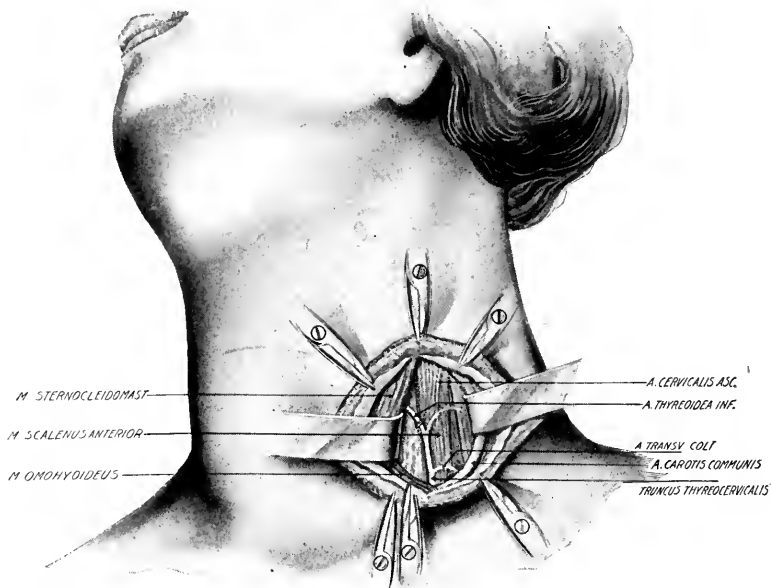


FIG. 4.—Appearance of field after dissection has been completed, showing ligation of inferior thyroid artery.

as closely as possible without opening it and the blades spread apart. The thyroid gland is then retracted inward with the sterno-mastoid muscle and the sheath of the carotid is retracted outward. The scalenus anticus muscle can be seen lying beneath covered by its fascia. The fascia is opened at the inner margin of the muscle and the inferior thyroid artery can be readily isolated (Fig. 4). It is essential that the operative field be kept absolutely dry throughout the whole procedure, because with oozing the landmarks are frequently lost and important structures may be injured.

Technical dangers which may be mentioned are, injury to the jugular vein, injury to the phrenic nerve which lies on the belly of the scalenus anticus muscle, and injury to the thyroid gland itself, thereby causing the typical reaction which occurs when thyroid tissue of this type is traumatized.

## EMPYEMA THORACIS

ANALYSIS OF TWO HUNDRED AND FIFTY CASES TREATED AT THE  
CHILDREN'S HOSPITAL OF PHILADELPHIA\*

BY HENRY P. BROWN, JR., M.D.

OF PHILADELPHIA, PA.

DURING the period from 1906 to 1922 there were 259 cases of empyema treated at the Children's Hospital and an analysis of end results with special reference to the method of treatment seemed desirable. I am indebted to Doctors Wharton, Jopson, Hutchinson, Hodge, Allen, Speese and Lee, upon whose services the cases were admitted, for the privilege of reporting them in this paper.

It is a well-known fact that empyema in children differs considerably from that occurring in adults, and it is for this reason that the cases from the Children's Hospital are presented.

The treatment varied according to the views of the chief on service at the time, but up to 1917-1918 the most frequently used method was exploratory aspiration to locate the collection, general anæsthesia and rib resection, the chest being drained with a fenestrated rubber tube.

As anyone knows who has endeavored to look up hospital records of a number of years ago, when there was apparently no one whose duty it was to supervise such records, there are often omitted many facts of interest and information which are essential for any review purposes. The Children's Hospital was not an exception in this, and in compiling this record of empyema cases, I have classified as "unknown" under the various subheadings when the fact in question is not definitely stated, even though it may be assumed that routine measures were followed.

As can be seen from a study of the "unknown" tables, this element does not alter the results very much one way or the other, but I have used it in order to make them as accurate as possible.

One of the most interesting questions in operating upon empyema cases in children, and one which has caused some discussion in Philadelphia, is rib resection *vs.* intercostal incision. Those in favor of incision claim that it can be done more readily than resection; it renders the child less subject to shock; it is not followed by rib necrosis; it is a shorter operation, and if the wound is kept open properly and the incision large enough, the drainage is just as satisfactory as when resection is done.

The resection adherents claim that it takes but very little more time to do a resection; it can be done with the same type of anæsthetic as the incision; it is not more shocking to the child; it allows of much better drainage.

---

\* Read before the Philadelphia Academy of Surgery, November 6, 1922.

At the present time the advocates of each method are about equally divided. Up to 1915 our records show that most of the surgeons did a resection, using a general anæsthetic, usually ether.

The term "cured" is a variable factor, some of the hospital internes writing up the records regarding a case as cured when the chest wound had entirely closed and remained so for several days. Others regarded a case as cured when the child was discharged with a small sinus that was draining, but without a drainage tube in it.

There were a few cases which demonstrated that occasionally each of these standards was at fault, but most of those discharged as cured evidently remained as such, for those of this type coming in for reoperation were quite rare. Of course, they may have gone to other hospitals for a secondary operation, but judging from the small number of cases operated upon elsewhere and later falling into our hands, there were not many who did not return to us when they had further trouble.

No attempt was made to follow up the cases and have them return for examination at the time this report was being prepared. In a city the size of Philadelphia with a large percentage of foreign population among the poorer classes, we have found that the people change their addresses quite frequently, often without leaving word as to their destination. Another factor is the failure to have the name properly spelled, sometimes our fault and sometimes theirs. The chief reason, however, is the fact that at the present time our Social Service Department is not large enough to enable its workers to search over the city for these cases.

The dispensary records show that most of the cases leaving the hospital as cured, with a small sinus, returned there until the sinus had closed entirely.

In view of the above facts there are classified as cured those cases discharged as cured when they left the hospital, and those discharged as improved are placed under improved, in studying the results for both resection and incision.

Studying the cases more carefully, there were 171 resections, 54 incisions, 2 aspirations, and in 34 the type of operation was not mentioned in the history, although most of the latter were done at the time when resection was the routine procedure. They are, however, classified separately for the reason stated above.

Beck's paste No. 1 was used in one case. This was a little fellow of seven who had had a resection in July, 1909, at which time a piece of his sixth rib was removed. A month later it was necessary to resect a portion of his seventh. He was discharged in September with a small sinus. In November of the same year he was readmitted and portions of the seventh, eighth and ninth were removed, exposing two pockets of pus. He was again discharged in January, 1910, with a sinus. In March he returned, the sinus still being open, and in April he was given three injections of Beck's paste No. 1 at four-day intervals. His chest closed and he



left the hospital in two weeks apparently cured, and we have not heard from him since.

Aspiration without subsequent thoracotomy was done twice. In one instance a little girl had a pyemia with abscesses of the elbow, hand and face. She developed signs of fluid in her chest and about 400 c.c. of bloody pus was aspirated. Her chest was not opened and she was later discharged in good condition only to return in two months with an osteomyelitis of one of her metacarpals.

The other was an infant of one and five-tenths years. Two c.c. of pus were removed with an exploring needle, the smear showing a pneumococcus. In three days another exploration gave a dry tap and the child was discharged eighteen days later in good condition, the chest having cleared.

Of the 171 resections, 70, or 40.8 per cent., were cured, 61, or 35.6 per cent., were improved, 3, or 1.7 per cent., unimproved, and 37, or 21.5 per cent., died. If we regard all of the cases as being either cured, unimproved or dead, the percentage of cures would be 76.0 per cent.

Of the 54 incisions, 9, or 16.6 per cent., were cured, 20, or 37 per cent., improved, 1, or 1.8 per cent., not improved, in 2, or 3.7 per cent., the condition at discharge was not stated, and there were 22, or 40.3 per cent., of deaths. Combining improved and cured as was done above, the cured would be 53 per cent.

TABLE I.

No. operated.	Cured	Per cent.	Improved	Per cent.	Not improved	Per cent.	Result not stated	Per cent.	Deaths	Per cent.	Days per case
Resections.....171	70	40.8	61	35.6	3	1.7			37	21.5	37
Incisions ..... 54	9	16.6	20	37.0	1	1.8	2	3.7	22	40.3	35
Not stated..... 34	16	47.0	6	17.3	1	2.9	3	8.8	8	24.2	42
Totals.....259	95	36.6	87	33.5	5	1.9	5	1.9	67	26.2	38

In only two of the fatal incision cases was the note made that the child was too sick for resection and an incision was therefore made. Each of these children died within twenty-four hours after operation. The exponents of incision sometimes claim that included in their mortality lists are cases too sick to resect, but our records of over 250 cases show that these two were the only ones of this type that are mentioned. It therefore seems that the mortality in each class is fairly representative.

There were 34 cases in which it was not stated what type of operation was done. Of these, 16, or 47.0 per cent., were cured, 6, or 17.3 per cent., improved. Combining these as was done above, it gives 64.7 per cent. cured. One, or 2.9 per cent., was not improved, in 3, or 8.8 per cent., the result is not stated, and there were 8, or 24.2 per cent., of deaths. These figures agree more closely with those of the resections, and there is no doubt, in view of the fact that most of them occurred before 1915 when practically all of the operations were resections, that they belong to this class. They are, however,

classed as "not stated" because of the desire to have the figures as accurate as possible.

The average number of days in the hospital per case was thirty-seven for resection and thirty-five for incision.

*Pneumonia, Post-operative.*—There were eight cases of post-operative pneumonia, of which six died and two recovered. Five of the fatalities had been resected and one had had an incision (this case died eighty-eight days after operation, the pneumonia obviously not being related to the type of

TABLE II.

	Died	Recovered
Post-operative pneumonia following	General 4	1
	Local 2	
	(one 88 days)	
	Not mentioned	1
Post-operative pneumonia in 4.7 per cent. of cases given general anæsthetic.		Mortality of 3.8 per cent.
Post-operative pneumonia in 4.0 per cent. of cases given local anæsthetic.		Mortality of 4.0 per cent.
	(excluding one case 88 days after operation.)	

operation, but it is nevertheless included in this group). One of the resections and one of the incisions recovered from the attack. Post-operative pneumonia thus occurred eight times in 259 operations, or 3.0 per cent., while the mortality from this cause was 2.3 per cent. All of these cases followed the primary operation, there being no record of it having followed a secondary operation. Table II shows the relationship between the type of anæsthetic and the number of cases of post-operative pneumonia.

TABLE III.

121 cases received general anæsthetic and recovered.
25 cases received general anæsthetic and died (17.1%)
146
30 cases received local anæsthetic and recovered.
12 cases received local anæsthetic and died (28.5%)
42
47 cases anæsthetic not stated recovered.
24 cases anæsthetic not stated died (33.7%)
71

*Type of Anæsthesia.*—A general anæsthetic was administered to 146 patients, of which number twenty-five died, a mortality of 20.1 per cent. Forty-two were done under local anæsthesia with twelve deaths, a mortality of 40.0 per cent. In seventy-one cases the type of anæsthesia was not stated and there were twenty-four deaths, a mortality of 51.0 per cent.

As mentioned in discussing resection, most of the cases in which the type of anæsthesia was not mentioned were done during the period when ether was the method of choice. This would raise the percentage mortality slightly in the general anæsthetic class.

# EMPHYEMA THORACIS

*Reoperations.*—The cases returning for reoperation are of interest and are shown in Table IV. They have been classified as: 1. Necrotic rib. 2. Discharging sinus (which includes insufficient drainage and failure of obliteration of the cavity), and one case in which the cause is not mentioned.

Of the 171 cases in which the primary operation was a resection, 7, or 4.0 per cent., returned for necrotic rib, 10, or 5.8 per cent., for discharging sinus, which with the one the cause of which was not given, gives a total of eighteen cases and a percentage of 10.5 requiring reoperation.

Of the fifty-four incisions, nine returned for reoperation, a percentage of 16.6. Here again resection seems to give a better result than incision.

TABLE IV.  
*Reoperations*

Resections		Incisions
(1) Necrotic rib..... 7	4.0% of total resections	
(2) Discharging sinus (insufficient drainage)... 10	5.8% of total resections	9
(3) Not mentioned..... 1	0.7% of total resections	
Condition following secondary operations:		
Cured..... 7		{ 1 following resection
Improved..... 11		{ 1 following incision
Not improved.....		6
		1
Number of secondary operations:		
One reoperation..... 16		6
Two reoperations..... 1		1
Three reoperations..... 1		1
Four reoperations..... 0		1
Intercostal incisions followed by {Incision 3		
{Resection 6		
Per cent. of resections needing secondary operation: 171 resections. 18 reoperations.		
10.5 per cent.		
Per cent. of incisions needing secondary operations: 54 incisions. 9 reoperations.		
16.6 per cent.		

Classified according to the number of secondary operations, of the resections, sixteen were reoperated upon once, one twice and one was reoperated upon three times.

In the nine incisions, six were reoperated once, one twice, one three times and one child, at present in the hospital, was reoperated upon four times. The original operation on this last child was an incision, and it has been followed by four rib resections, the last one having been done according to the method advocated by Colonel Keller of the Walter Reed Hospital.

In three of the cases in which the primary operation was an incision, the secondary was also an incision. In six, the original being an incision, a secondary resection was done.

Regarding the results of reoperation, seven of the resections are classified as cured and eleven improved. For the reason mentioned elsewhere in discussing cured and improved, it seems fair to classify these eighteen cases as being cured, for as far as our records go, none of them have died from

their empyema and none of them are at present under treatment at the hospital.

Of the incisions, two were cured, six improved (a total of eight cured) and the case still in the hospital after having had four reoperations is classified as unimproved, but is still under treatment.

*Age.*—Table V shows that, according to our records, the greatest number of cases occur in the second year, under the figure 1 in the table. The mortality at this age was twenty-eight of sixty-five cases, 43.0 per cent. In the first year it was 40.7 per cent. in twenty-two cases. As the age increased the mortality tends to decrease, this being in accord with most observers.

*Complications.*—As complications in fatal cases, gangrene of the lung occurred once; post-operative pneumonia eight times, as mentioned else-

TABLE V.  
*Mortality by years*

Age	No. of cases	Deaths	Percentage of deaths
0	22	9	40.7
1	65	28	43.0
2	55	12	21.8
3	29	11	37.9
4	33	4	12.1
5	24	2*	8.3
6	17	1	5.8
7	8	2	25.0
8	6	0	0
9	4	1	25.0
10	3	1	33.3
11	1	0	0

where; bronchial fistula with lung abscess twice; bronchial fistula once; tuberculous peritonitis once; empyema of the opposite side once; embolus once; lung abscess once; undetermined rash twice.

Of the cases that recovered, undetermined rash occurred once; diphtheria six times; measles three times; scarlet fever six; chicken-pox two; otitis media once and one case had an abdominal infection.

*Dakin Solution.*—Dakin solution was used in fourteen of the cases, obviously too small a number to warrant drawing any conclusions of value. It was not administered in a uniform manner in each case, some receiving second-hour instillations while others were merely irrigated with it at the time of dressing, depending more or less on how well the child stood the treatment. Under this procedure, necessarily far from perfect, the duration of the empyema was not markedly shortened, varying from twenty-one to eighty days with an average of 49.9. It was usually started on the third or fourth day after operation. A study of the cases gives the impression that the Dakin solution, *per se*, has not been of much benefit in the comparatively few cases in which it has been tried. This conclusion is of course open to the criticism that the technic was at fault. In several of the cases, when the profuse purulent discharge had diminished, a 2 or 5

# EMPHYEMA THORACIS

per cent. solution of dichloramine-T was used with apparently good results. In only two instances was the notation made that the children did not stand the irrigation well and in no case did a bronchial fistula follow its use. At least one of our surgeons is convinced that its action is deleterious in young children.

Recently a few of the closed types of operation have been done, an attempt being made to make an air-tight closure between tube and chest wall, the free end of the tube being conducted beneath a solution in a bottle at the side of the bed. By means of a Y glass connection the pleural cavity can

TABLE VI.  
*Complications*

	Fatal		Recovered
	Resect.	Incision	
Gangrene of lung .....	1		
Pneumonia of opposite side .....	6	1	1
Bronchial fistula—lung abscess .....	1	1	
Bronchial fistula .....			1
Tuberculous peritonitis .....	1		
Empyema opposite side .....	1		
Embolus? .....		1	
Lung abscess .....		1	
Gangrene of lung .....		1	
Undetermined rash .....	1	1	1
Diphtheria .....			6
Measles .....			3
Empyema following appendectomy ..			1
Otitis media .....			1
Scarlet fever .....			4
Chicken pox .....			2

be irrigated as often as desired. This was usually maintained for four or five days and then simple direct drainage instituted.

If aspiration is done until adhesions form, as indicated by the fluid becoming frankly purulent, and then a thoracotomy done, the records show that in children simple direct drainage by means of a rubber tube gives as good results as any of the other methods tried. In no case was mention made of mediastinal fluttering or other evidence of cardiac embarrassment due to the direct opening of the chest.

The pneumococcus and staphylococcus were the organisms most frequently found on culture.

In conclusion, from a study of the above cases, it would seem that the best results were obtained by exploratory aspiration with removal of enough of the pleural exudate to relieve symptoms from pressure, until adhesions had formed. This can be determined by the fluid becoming frankly purulent, except sometimes in the case of streptococcus. Drainage is then instituted by rib resection, using either local or general anæsthesia (nitrous oxide-oxygen) according to the preference of the operator, a simple fenestrated rubber drainage tube being inserted. If Dakin solution is used it

should be so administered that the fluid comes into contact with all parts of the empyema cavity. This can be accomplished by having the child lie in such a position during the irrigation that the sinus opening is at the highest level, the cavity then being filled till it overflows.

In a small series of cases in another hospital I have started the irrigation within four or five hours after operation, and have not as yet encountered any deleterious effects that could be ascribed to its use. In most instances where it was used the duration of the use of the drainage tube was considerably shortened.

Sometimes in a large cavity if it be entirely filled as mentioned, the weight of the solution will exert undue pressure on the mediastinum, causing dyspnœa, etc. If the solution is carefully introduced, its administration can be stopped before this stage is reached.

As the discharge diminishes and becomes glairy, the irrigations are stopped, the tube shortened and 2 to 5 per cent. dichloramine-T substituted for the Dakin. The tube should not be kept in too long a time, it usually being removed when the discharge has lost its purulent character (5 to 15 organisms per field) and is considerably diminished in amount. At the time of dressing each day for three or four days after the removal of the tube, a small catheter is introduced into the sinus in order to relieve any collection that may have formed. A few c.c. of dichloramine-T may be injected before removing the catheter.

If the temperature does not rise for four or five days after removal of the tube, the chest will usually close satisfactorily. No attempt to make a secondary closure of the chest after sterilization should be done.

If the child is old enough, lung exercises such as blowing water from one bottle to another will help in reëxpanding the lung.

# THE EXPERIMENTAL PRODUCTION OF PEPTIC ULCER\*

BY FRANK C. MANN, M.D.

AND

CARL S. WILLIAMSON, M.D.

ROCHESTER, MINN.

DIVISION OF EXPERIMENTAL SURGERY AND PATHOLOGY, THE MAYO FOUNDATION

THE most important and almost the only uncontradicted fact with regard to peptic ulcer is its anatomic and physiologic location. These absolutely typical ulcers occur only in that portion of the gastro-intestinal tract which can be exposed to the action of a mineral acid. Whatever may be the cause or causes of such ulcers, and however important or unimportant the relation of acid to their production, it would seem to be of the greatest significance that they occur chiefly in the portion of the gastro-intestinal tract which, although secreting an alkaline secretion, may have an acid secretion poured over it. This is true not only of gastric and duodenal ulcers, but also of gastrojejunal ulcer, a rarer form of peptic ulcer. Such ulcers follow gastro-enterostomy and are located at a point where they may be subjected to an acid medium.

Acute gastric or duodenal ulcers may be produced experimentally with relative ease, and the methods employed to produce them successfully are numerous.† Few of these methods can have any significance with regard to the cause of the ulcer in man. Rosenow's method is an exception; he produces ulcer by the administration of specific bacteria. It should be noted that these acute ulcers are produced experimentally by any method only in the proportion of the gastrointestinal tract in which there may be acid.

Very little success has been attained in the experimental production of the typical chronic or subacute peptic ulcer as it occurs in man. The acute ulcer which can be produced so readily and by so many methods, either heals spontaneously, or its occurrence is associated with and probably secondary to a condition resulting in death.

Many attempts have been made to evaluate acid as a primary or secondary factor in the cause of peptic ulcer. The results of such attempts have led to diametrically opposite conclusions. Certain observers believe the acid to be directly responsible for the ulcer, while others believe that there is no causal relationship. Of those holding the former view, some believe that the ulcer develops in association with an overproduction of acid, or an increase in the degree of acidity, and others, that it develops when there is a decrease in the amount or degree of acidity. Neither of these viewpoints have been proved, but there is evidence to substantiate both.

---

\* Read before the Buffalo Academy of Medicine, Buffalo, New York, January 3, 1923.

† So much work has been done experimentally on ulcer that it is impractical to give a complete list of references. Bolton, Butsch, Durante, Gregg and Ivy give good reviews.

Numerous experimental investigations have been made to determine the relation of acid to ulcer. The most direct attempts have included the administration of acid or alkali, with or without operative procedures. It is very difficult to administer a substance so as to simulate the normal elaboration and secretion of that substance. Thus acid by mouth cannot be given over periods long or constant enough to make its effect quite comparable to that secreted by the gastric glands. The results of such experiments, therefore, have been more or less negative.

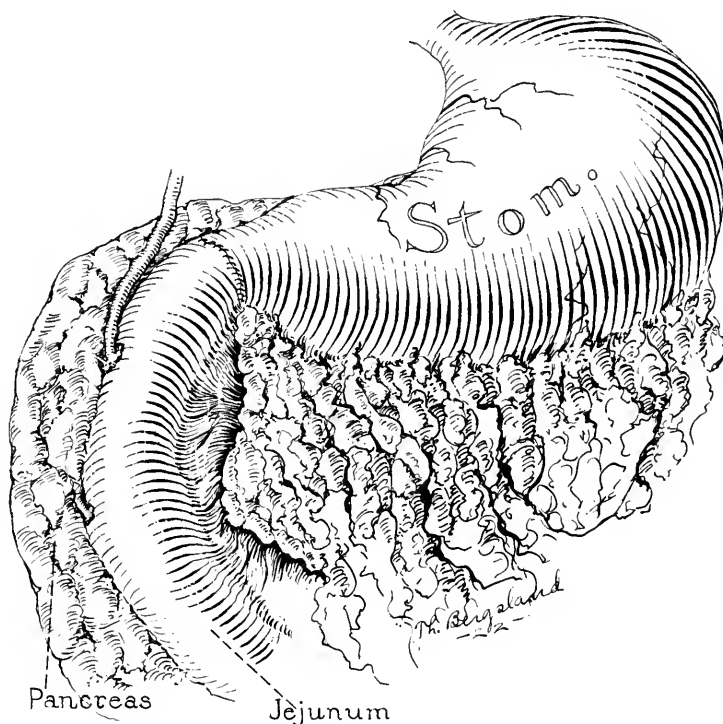


FIG. 1.—Diagram illustrating the operative procedure in the first series of experiments in which the duodenum was removed. Continuity of the gastro-intestinal tract was maintained by anastomosis of jejunum to the stomach. The bile and pancreatic ducts were transplanted into the former.

The degree of acidity and the amount of acid to which the ulcer-bearing area of the gastro-intestinal tract is subjected depends not only on an acid producing mechanism, but on an alkaline producing mechanism. The acid secreted by the gastric mucosa must be neutralized before the action of the pancreatic enzymes can be effective. The neutralization not effected by the food must be effected by this alkaline mechanism, which consists of three secretions, the intestinal secretion (also that of the pyloric mucosa<sup>6</sup>), the pancreatic juice, and the bile. Enough alkali must be produced by these combined secretions to neutralize the acid that passes the pylorus if digestion in the intestine is to be carried out normally. The upper portion of the intestinal tract can be subjected to an acid medium just



## EXPERIMENTAL PRODUCTION OF PEPTIC ULCER

as effectively by damaging the alkaline mechanism as by the administration of acid, thus avoiding the difficulties of such administration. It is our purpose here briefly to review the results of some of the experiments conducted for the purpose of injuring or destroying the alkaline mechanism.

*Methods of Experimentation.*—The experiments were conducted on dogs, in whom spontaneous ulcer is rare.<sup>7, 8, 12</sup> The operations were performed under ether anaesthesia, and with sterile technic. Since the purpose of the experiment was to injure one of the major factors of digestion, one of our technical

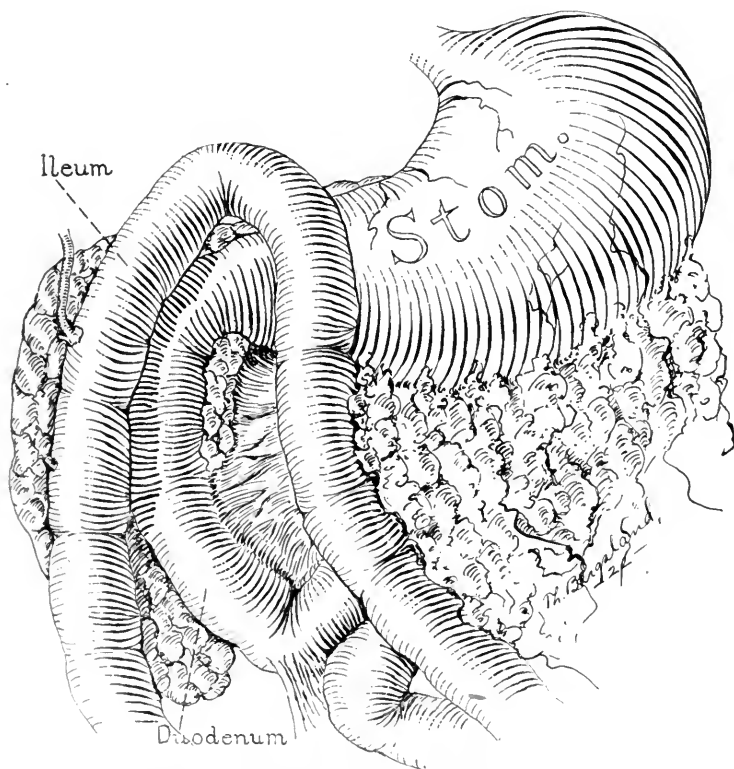


FIG. 2.—Diagram illustrating the operative procedure in the second series of experiments in which the bile and pancreatic ducts were isolated, sectioned and transplanted into a loop of ileum.

problems was dietetic. The animals were fed with great care, nevertheless the maintenance of their physical condition was only partially successful. Four series of experiments were performed. In the first series the duodenum was removed, thus eliminating the portion of the intestine which had most to do with producing the necessary alkali to neutralize the acid. In the second series the pancreatic and bile ducts were transplanted to the terminal ileum, thus eliminating the value of these secretions in neutralizing the gastric juice. In the third series the duodenum was removed and the pancreatic and bile ducts transplanted to the terminal ileum. In the last series the duodenum was

functionally resected and made to drain its own secretion and that of the pancreas and liver into the lower portion of the ileum.

*Results of Experiments, the Development of Ulcer Following Duodenectomy.*—Of the first series of experiments, the removal of the duodenum, the operative technic and general results will not be reviewed, since they have been reported in connection with other experiments;<sup>9, 10</sup> the results pertaining to the development of ulcer only will be discussed. It should be understood that the duodenum was completely removed; the first portion of the jejunum was anastomosed to the stomach and made to occupy the position held by the duo-

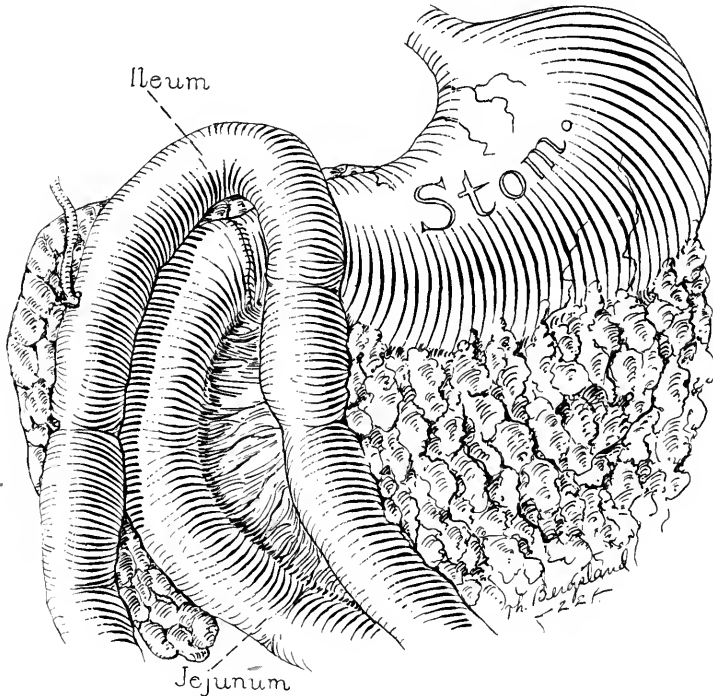


FIG. 3.—Diagram illustrating the operative procedure in the third series of experiments in which the duodenum was removed and the bile and pancreatic ducts were transplanted into a loop of ileum. The procedure thus consisted of a combination of those employed in the first and second series.

denum, and the common bile duct and pancreatic duct were transplanted into it at about the same distance from the stomach as they were originally (Fig. 1). After we had perfected the technic, the removal of the duodenum was accomplished very successfully. The animals remained in good condition for long periods, one dog was in excellent condition four years after duodenectomy. The post-operative course in ten of the dogs was followed for periods varying from three hundred twenty-five to five hundred fifty-six days. Two of these animals coming to necropsy, three hundred ninety-three and five hundred fifteen days, respectively, after operation, had typical chronic peptic ulcers.

*The Development of Ulcer Following the Transplantation of the Bile and*

*Pancreatic Ducts to the Terminal Ileum.*—In a second series of experiments the secretions of the liver and pancreas were made to drain into the terminal ileum. The object of these experiments was to remove from the duodenum whatever of value the secretions might possess in neutralizing the gastric juice. The operative technic consisted in isolating and sectioning the bile and pancreatic ducts and transplanting them into the ileum, 30 to 50 cm. from its termination (Fig. 2). The method of transplanting the ducts has been described.<sup>9, 10</sup> The animals recovered from the operation and, with careful

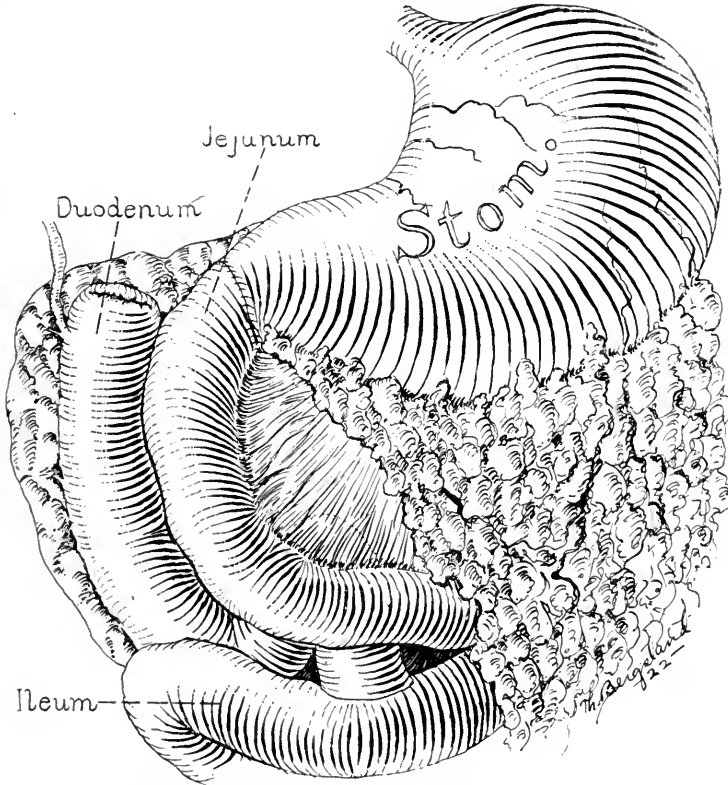


FIG. 4.—Diagram illustrating the operative procedure in the fourth series of experiments in which the duodenal, liver, and pancreatic secretions were made to drain into a loop of ileum.

feeding, in some instances remained in good condition. However, in most cases there was a variable loss of weight. In thirty-one experiments in this series in which the animal lived eight days or longer, definite ulcer developed in ten; five of the ulcers were of the characteristic subacute or chronic type.

*The Development of Ulcer Following Duodenectomy and Transplantation of the Bile and Pancreatic Ducts to the Terminal Ileum.*—The partial success in producing ulcer by the procedures employed in the first and second series of experiments led us to conduct another series in which these procedures were combined. The duodenum was removed as in the first series, and the jejunum made to occupy the position formerly occupied by the duodenum. The bile and

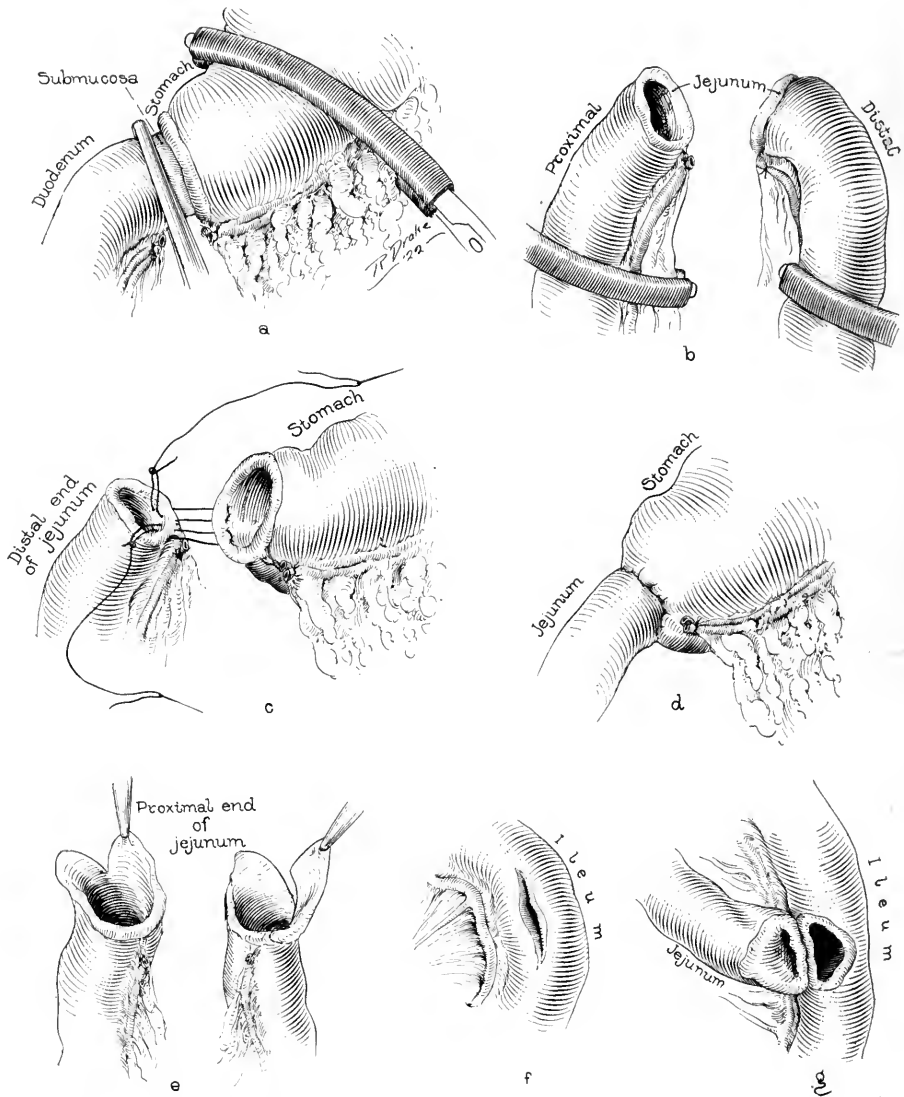


FIG. 5.—A series of drawings illustrating the operative procedures in the fourth series of experiments. In (a) the pylorus is isolated and incised down to the mucosa; in (b) the first portion of the jejunum is isolated and sectioned; in (c) and (d) the distal end of the jejunum is anastomosed to the stomach; in (e), (f), and (g) the proximal end of the jejunum is anastomosed to the ileum.

## EXPERIMENTAL PRODUCTION OF PEPTIC ULCER

pancreatic ducts, however, were not transplanted into the jejunum but into the terminal ileum. This removed all three of the neutralizing secretions from the point of emergence of the gastric juice from the stomach into the intestine (Fig. 3).

The removal of the duodenum and the transplantation of the ducts into the ileum were accomplished with comparative ease, but the combination of the two procedures resulted in a high mortality. The entire gastro-intestinal contents were involved in the operation and the ducts were transplanted in a region where bacteria abound. Most of the animals could not be kept in good



FIG. 6.—A subacute ulcer of the duodenum which produced death by perforation fifty-seven days after transplantation of the bile and pancreatic ducts to a loop of the ileum (F. 700).

physical condition following the procedure. However, of ten animals coming to necropsy within twelve to one hundred twenty-four days after operation, eight showed ulcer; seven of the ulcers were of the subacute or chronic type.

*The Development of Ulcer After Functional Resection of the Duodenum.*—Although well developed chronic ulcer was found in a high percentage of the animals operated on in the third series of experiments, the operative mortality was necessarily high. In order to simplify the procedure and to make it possible to keep the animals in better condition, a fourth series of experiments was performed in which the duodenum was made to drain its own secretion and that of the liver and pancreas into the intestine at a considerable distance from the pylorus. Briefly, this procedure consisted of (1) exposure, isolation and

section of the pylorus with inversion and closure of the duodenal end, (2) section of the first portion of the jejunum, (3) end-to-end anastomosis of the distal end of the jejunum to the stomach and (4) end-to-side anastomosis of the proximal end of the jejunum to the ileum at a variable distance (25 to 75 cm.) from the cæcum (Figs. 4 and 5).

Several important procedures were found to be advisable in order to insure the success of the operation and to remove objectionable features with regard to the development of ulcer. All three sites of operations were prepared and all

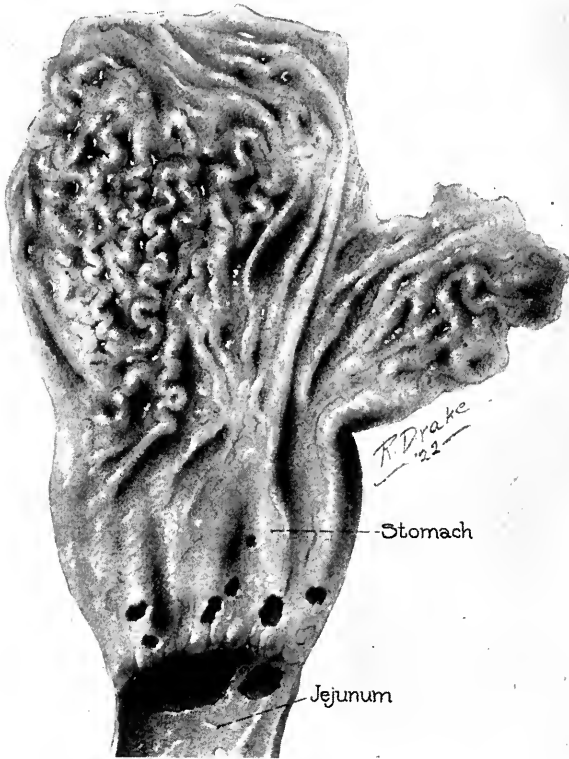


FIG. 7.—Acute, multiple ulcers of the stomach and jejunum found nineteen days after draining the duodenum into the ileum. Death was due to hemorrhage from the ulcers (F. 784).

incisions made down to the mucosa before the lumen of the gastro-intestinal tract was entered. The blood-vessels to the jejunum were carefully protected. It is usually best to divide all or part of the ligament of Treitz. Intestinal clamps were used only to prevent soiling and were always placed at a distance from the suture line. Two rows of No. 00 chromic catgut were used. After adopting these procedures practically all the operations were successful and the animals were kept in good or fair

physical condition. Many thus operated on are still alive and in fair condition. Fourteen of sixteen animals coming to necropsy had ulcers, all of the subacute or chronic type.

*General Effects of the Operative Procedure upon the Animal.*—As we have mentioned, the operative procedure necessarily was very injurious to the digestion of food in the intestine, consequently most of the animals did not maintain their normal physical condition. In some instances, in spite of painstaking care, they steadily lost weight. However, many that had ulcer lost but little weight and in some instances practically normal nutrition was main-

tained. Rarely was there an actual increase in weight. In some animals the weight remained about the same as before operation for a considerable time, and then suddenly decreased. In all such, ulcer was found, and it seems quite possible that the sudden loss of weight followed the formation of the ulcer. This is emphasized by the fact that in a few experiments exploration was made immediately after the decrease in weight was noted and ulcer was found.

*Characteristics of the Ulcers, Time of Occurrence.*—All but two animals

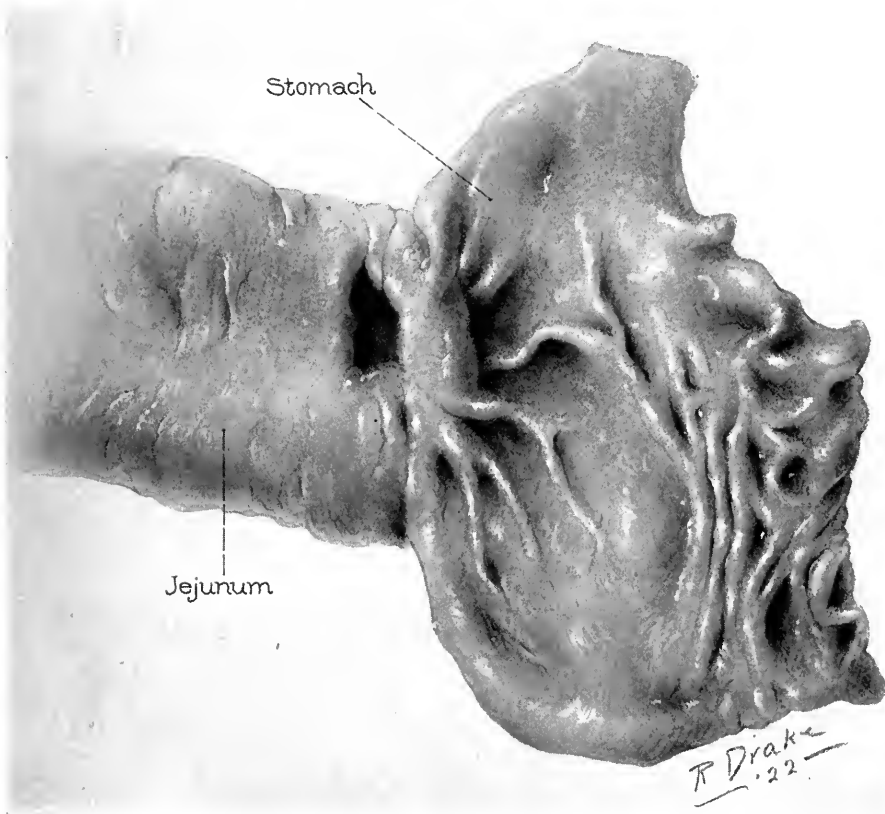


FIG. 8.—A chronic ulcer found one hundred and twenty-five days after the removal of the duodenum and transplantation of the bile and pancreatic ducts into a loop of ileum (F 609).

coming to necropsy less than two weeks after operation did not have ulcer. In two instances acute ulcers were present earlier, and one caused death by perforation. All the ulcers of the subacute or the chronic type were noted usually two or more weeks after operation; the usual time for the development of the ulcer appeared to be during the third or the fourth week after operation.

*Location of the Ulcer.*—The ulcer was usually located in the intestine a few millimetres distal to the pyloric mucosa. In certain instances there were multiple ulcers in the pyloric mucosa. In the experiments in which the duodenum was not disturbed (in which the ducts only were transplanted), the



FIG. 9.—A subacute ulcer which produced death by perforation fifty days after draining the duodenum into the ileum. An ulcer was suspected in this animal because of the sudden decrease in weight, and an exploratory operation was performed on the forty-sixth day after operation. The ulcer was found almost to have perforated. Omentum was sutured around the lesion in the hope of preventing perforation. This was not successful, as perforation and death occurred four days later (F 748).



FIG. 10.—A subacute ulcer obtained forty days after draining the duodenum into the ileum (F 472).



## EXPERIMENTAL PRODUCTION OF PEPTIC ULCER

ulcer was usually anteriorly on the left side. In the experiments in which the jejunum was anastomosed to the stomach, the ulcer was usually slightly posterior and on the right side; it rarely touched the suture line.

*Size and Shape of Ulcers.*—Most of the ulcers were relatively large. They measured from 4 to 15 mm. in diameter. The acute types were irregular in shape, and usually longer in relation to the transverse diameter of the intestine. The chronic type usually were round or elliptical.

*Number of Ulcers.*—As a rule only one ulcer was present; in some instances there were two ulcers, but very rarely were they multiple.

*Gross Description.*—The common type of ulcer appeared, grossly, like

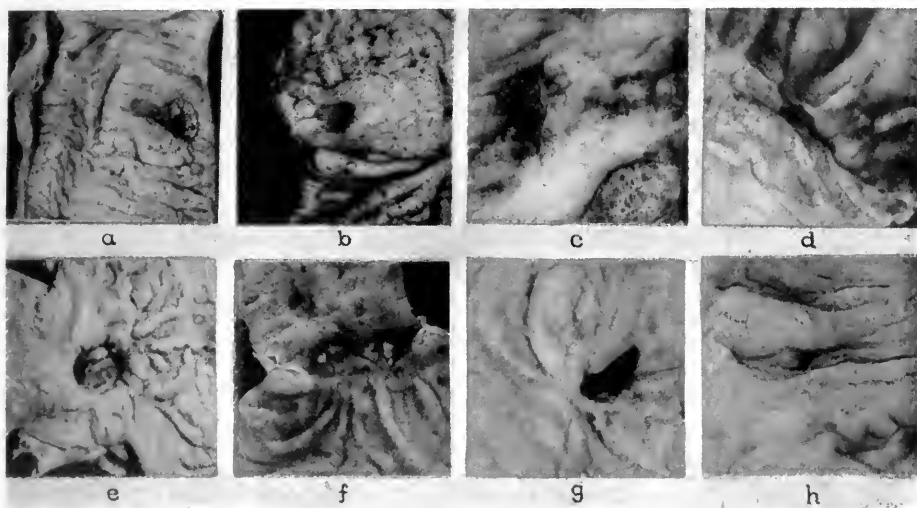


FIG. 11.—A series of acute, subacute and chronic ulcers which followed the various operative procedures described.

the peptic ulcer noted in man. It was more or less circular, punched out, and with overhanging edges. It always involved the entire thickness of the mucosa and usually penetrated considerably deeper in the intestinal wall. The base was hard to the touch, and on section was thick and oedematous. In several instances the ulcer was of the perforating type and passed completely through the intestinal wall; sometimes such perforations were closed by the adjacent coil of intestine, omentum or pancreas. In other instances leakage with peritonitis and death occurred. In one instance a fatal hemorrhage occurred from multiple ulcers.

*Microscopic Description.*—Microscopically the ulcers appeared to be similar to the subacute and chronic type noted in man. There was destruction of the mucosa and of the intestinal wall down to the base of the ulcer, with leukocytic infiltration and the initial proliferation of connective tissue. In many of the ulcers the base was composed entirely of connective tissue.

*Discussion.*—A method for the consistent production of a type of peptic

ulcer, which in all its characteristics is similar to the subacute or chronic ulcer that is found in man, was devised through this series of experiments.

We are not as yet in a position to make positive statements with regard to the development of, or the factors responsible for the production of such ulcers. It should be emphasized, however, that the success of the method of producing ulcer was due to the presumption that the acid or lack of alkali is an important etiologic factor. Whether or not this was correct, future studies must decide, but in any event our methods have been successful



FIG. 12.—Photomicrograph of subacute ulcer obtained twenty-eight days after draining the duodenum into the ileum. At the site of the section the ulcer has not quite perforated through the muscularis.  $\times 8$  (F 780).



FIG. 13.—Photomicrograph of subacute ulcer obtained twenty-nine days after draining the duodenum into the ileum. The ulcer has perforated through the entire thickness of the jejunal wall. Note overhanging edge.  $\times 8$  (F 774).

in producing the characteristic lesion. We are conducting studies which we hope will add further data with regard to acid as a factor in the cause of ulcer, and shall continue the investigation in association with Rosenow ‡ concerning the part bacteria may play.

*Summary.*—Experiments were devised for diverting the secretions which neutralize the gastric juice, as it leaves the stomach, to another portion of the intestine removed from the point of emergence of the acid. Under such conditions typical subacute or chronic peptic ulcer, quite comparable pathologically to that found in man, developed in the intestinal mucosa just adjacent to the gastric mucosa in a high percentage of cases.

‡ Stained sections of some of the ulcers were studied by Doctor Rosenow and evidence of an infective process containing a paired streptococcus was found. A culture of fresh tissue of one of the ulcers yielded a streptococcus which produced acute gastric and duodenal hemorrhages and ulcers in a high percentage of rabbits injected, and few or no lesions elsewhere.

## EXPERIMENTAL PRODUCTION OF PEPTIC ULCER

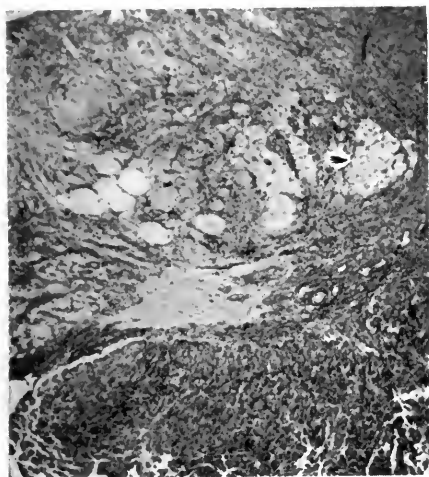


FIG. 14.—An area through the base of the ulcer shown in Figure 13. The base of the ulcer is made up entirely of newly formed connective tissue, omentum and pancreas. (x 25.)

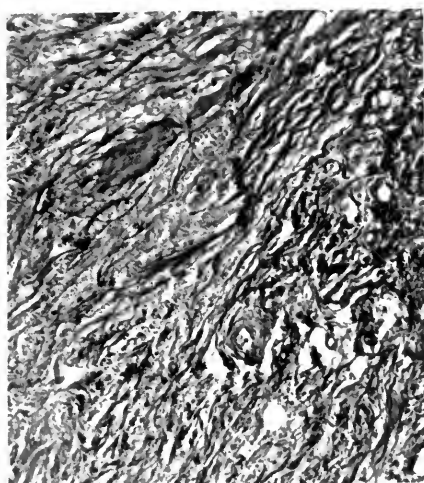


FIG. 15.—A higher magnification of an area of Figure 14, showing the newly formed connective tissue. (x 100.)



FIG. 16.—Photomicrograph of chronic ulcer. This ulcer is shown grossly in Figure 8. (x 8.)

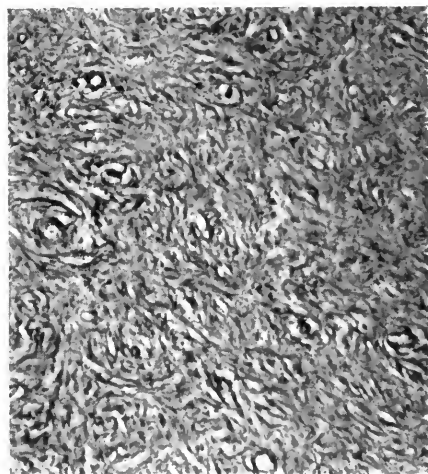


FIG. 17.—Photomicrograph of base of ulcer shown in Figures 8 and 16. The entire base of the ulcer is composed of connective tissue which has been formed for a considerable period of time. (x 100.)

BIBLIOGRAPHY

- <sup>1</sup> Bolton, C.: *Ulcer of the Stomach*. London, Arnold, 1913, 396 pp.
- <sup>2</sup> Butsch, J. L.: *Ulcers of the Gastrointestinal Tract with Special Reference to Gastrojejunal Ulcers*. Papers from the Mayo Foundation and the Medical School of the University of Minnesota, 1915-1920, vol. i, pp. 57-84.
- <sup>3</sup> Durante, L.: The Trophic Element in the Origin of Gastric Ulcer. *Surg., Gynec. and Obst.*, 1916, vol. xxii, pp. 399-406.
- <sup>4</sup> Greggio, E.: Des ulcères gastroduodénaux. *Arch. d. méd. exper. et d'anat. path.*, 1916-1917, vol. xxvii, pp. 533-590.
- <sup>5</sup> Ivy, A. C.: Studies on Gastric and Duodenal Ulcer. *Jour. Am. Med. Assn.*, 1920, vol. lxxv, pp. 1540-1542.
- <sup>6</sup> Ivy, A. C.: Contributions to the Physiology of the Stomach. *Studies on Gastric Ulcer*. *Arch. Int. Med.*, 1920, vol. xxv, pp. 6-31.
- <sup>7</sup> Ivy, A. C., and Oyama, Y.: Secretion of Pars Pylorica Gastri. *Am. Jour. Physiol.*, 1921, vol. lvii, p. 51.
- <sup>8</sup> Mann, F. C.: A Study of the Gastric Ulcers Following Removal of the Adrenals. *Jour. Exper. Med.*, 1916, vol. xxiii, pp. 203-210.
- <sup>9</sup> Mann, F. C., and Kawamura, K.: An Experimental Study of the Effects of Duodenectomy. A Preliminary Report. *Jour. Am. Med. Assn.*, 1919, vol. lxxiii, pp. 878-880.
- <sup>10</sup> Mann, F. C., and Kawamura, K.: Duodenectomy. *ANNALS OF SURGERY*, 1922, vol. lxxv, pp. 208-220.
- <sup>11</sup> Rosenow, E. C.: The Causation of Gastric and Duodenal Ulcer by Streptococci. *Jour. Infect. Dis.*, 1916, vol. xix, pp. 333-384.
- <sup>12</sup> Taylor, F. J.: Duodenal Ulcer in the Dog. *Vet. Jour.*, 1922, vol. lxxviii, pp. 343-344.

## THE RELATIONSHIP BETWEEN CERTAIN FORMS OF INTESTINAL OBSTRUCTION, CHRONIC PERITONITIS AND CHRONIC MULTIPLE SEROSITIS\*

BY CHARLES N. DOWD, M.D.

OF NEW YORK, N. Y.

IN 1908, before the Surgical Section of the American Medical Association, Dr. Miles F. Porter<sup>1</sup> of Fort Wayne, Ind., and Dr. William H. Welch of Johns Hopkins University, presented a remarkable specimen of an intestine which had become so shriveled up by an investing "false membrane" that intestinal obstruction and death resulted. The investing membrane covered the entire small intestine and part of the large intestine. It was grayish-white, rather strong, about 1 mm. in thickness, almost cartilaginous and translucent over most of its extent. The peritoneum was replaced by this organizing exudate and connective tissue. The process of contraction had absorbed 70 to 80 per cent. of the length of the small intestine, the mucous membrane had correspondingly been puckered up into transverse folds so that the lumen was practically obliterated. When the "false membrane" was divided by numerous transverse cuts, the corresponding part of the intestine could be pulled out to its original length and the infolding of mucous membrane disappeared.

The etiology was not understood. No similar condition had been seen by those who studied the case. Doctor Welch's pathologic diagnosis was "Chronic organizing peritonitis of unrecognized etiology; intestinal obstruction resulting from numerous transverse infoldings or constrictions of the intestinal wall, these being held in place by bridges of dense organizing false membrane."

The uncanny thought of a contracting investing membrane slowly shriveling up one's intestines until he must die, naturally made a vivid impression on those who saw the specimen, and each one probably hoped he would never see a similar case.

My own turn for the similar case came thirteen years later.

*Case Report.*—On May 11, 1921, a man of forty-six was transferred from the medical to the surgical division of the Roosevelt Hospital (History A18153). He complained of pain and a mass in the lower part of his abdomen.

His health had been good until two years before, when he had noticed the mass, believing it due to a strain from lifting. It had been moderately painful. He had suffered from constipation and had lost 22 pounds in weight, but he had continued his work as a doorman until two days before admission. He then apparently had an attack of definite intestinal obstruction with great pain and excessive vomiting. The attack lasted for 12 hours. The pain was cramp-like and its maximum intensity was at the location of the tumor. Following it, he had bowel movements, but was so ill as to seek relief in the hospital. Routine physical and laboratory examination revealed no abnormality, excepting the mass in the lower part of the abdomen

---

\* Read before the New York Surgical Society, December 13, 1922.

about 25 by 10 cm. in its diameters, oval, dull on percussion, slightly movable, slightly tender, its centre below the umbilicus. There was a distinct depression between it and the pubes.

Catheterization of both ureters; pyelograms and cystograms; and X-ray pictures of the colon revealed no abnormality.

He was serving in the British Army when the mass was first noticed, otherwise no important element was found in either his personal or family history.

*Operation, May 14, 1921.*—Eight inch incision through the inner portion of the lower part of right rectus. Peritoneum could not be distinguished as a definite



FIG. 1.—Tumor composed of four-fifths or more of the small intestine, shortened, convoluted and angulated by a dense, investing fibrous membrane.

layer. Numerous indefinite thin portions of tissue which apparently represented peritoneum and which had evidently been the seat of some form of inflammation were present. These encased a lobulated irregular mass which was about 24 cm. long and 10 cm. wide. It was a long time before its nature could be made out. In its posterior wall, there was a small calcareous nodule.

On delivering it little by little and separating the adventitious pseudo-peritoneum, the retroperitoneal space was exposed. It was finally found that the tumor was composed of convoluted and adherent small intestine bound into an irregular mass by some peculiar pathological process.

The intestine which entered it from above looked fairly healthy but was moderately distended. The terminal 20 cm. of the ileum emerged from it below. It was manifest, that life could not continue with the intestine thus obstructed and hence the mass was removed after clamping and cutting the intestine above

and below. The upper (afferent) intestine was adherent to the right kidney and was separated from it with considerable difficulty. Its open end was then inserted through the wall of the ascending colon near the caput coli, forming an end-to-side anastomosis, secured by two rows of stitches. The open end of the lower (efferent) intestine was inverted and secured by purse-string sutures.

The patient did well for a few days, then a leak occurred at the site of the anastomosis. Thin fluid with much digestive power leaked away and on the 33rd day he died of inanition.

The appearance of the mass after its removal is shown in Fig. 1. *Gross Pathologic Report.*—It was lobulated, mostly firm in its consistency, but soft in some spots. It was composed of constricted, convoluted, angulated small intestine and shriveled mesentery, all bound together by dense adhesions and bands of fibrous

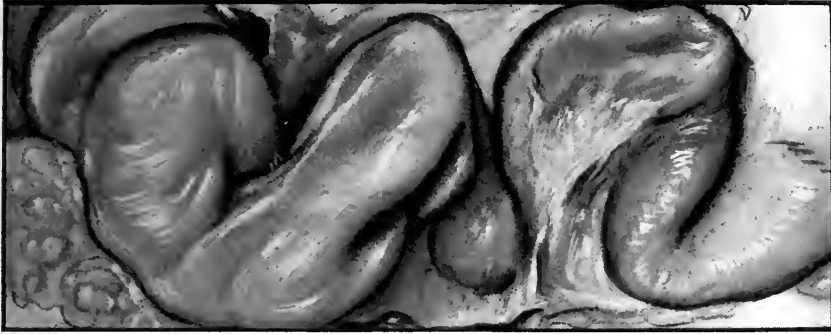


FIG. 2.—A portion of the intestine pulled out so as to show the appearance of the convolutions.

tissue (Fig. 2). When cuts were made into the intestine it was impossible to follow its lumen far on account of the angulations. In the mesenteric border there were some calcareous nodules.

When the intestine was cut across it was seen that the puckered mucous membrane nearly filled its lumen, as shown in Fig. 3. The appearance of the folds of mucous membrane is shown in Fig. 4. Apparently the contracting fibrous tissue outside the main intestinal wall had puckered and infolded the mucous membrane within. This appearance corresponded closely to Doctor Welch's description, but this infolded mucous membrane was not so firm nor was the investing membrane so definite as in his case. The investing membrane was irregular in its contour and could not be stripped off as a definite sheet. Nor was it possible to restore the intestine itself to its original length by making multiple incisions in this membrane, since it was too adherent to the intestinal wall to be satisfactorily separated. There was, however, a sausage-like feel to the intestine where its lumen had been filled up by the puckered mucous membrane. Those who saw the original specimen estimated that three feet or possibly a little more of the intestine had been removed. This was manifestly a very defective estimate, unless the intestine was congenitally short some fifteen or more feet of its length must have been shriveled into this contorted specimen. This corresponds to the statement of Porter and Welch that 70 to 80 per cent. of the intestinal length in their specimen had been absorbed by this process of contraction.

*Autopsy Report.*—A limited autopsy was permitted through the site of the operation incision. It was reported that the peritoneal cavity had been completely obliterated. At the site of the anastomosis between the jejunum and the ascending colon there was a small leak (5 mm. wide) with necrotic tissue about it. The length of the intestine above the anastomosis was only 16½ inches. The stomach,

liver, pancreas, spleen and kidneys were not removed but their size and position were apparently normal.

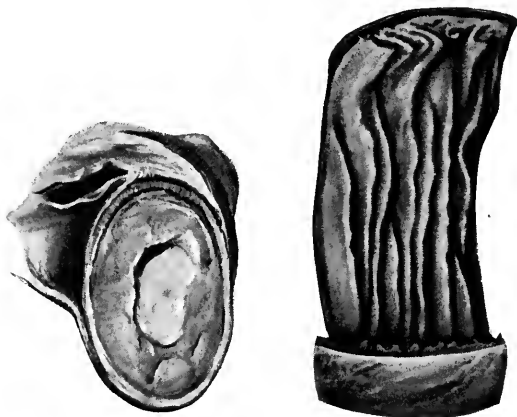
It is believed that digestive quality of the fluid in the upper part of the jejunum was an element in the breaking down of the anastomosis and in the necrosis about it.

It is surely most remarkable that this pathological process could have contracted the greater part of the small intestine into a firm mass not much larger than two good fists.

Sections were cut from the intestinal wall; the microscopical slides are depicted in Figures 5, 6, 7.

*Microscopical Report.*—By Dr. Wm. C. White and Charles W. Lester, Roosevelt Hospital, May and June, 1921. History number A 18153. Pathological

number S. A. 8924. Sections were cut through the intestine both longitudinally and transversely at: (1) the portion whose lumen was practically occluded, (2) various more proximal portions whose lumen was patent but where the intestine was coiled by a veil of adhesions.



FIGS. 3 and 4.—Cross section of the intestine, showing the lumen almost occluded. Short section of intestine cut longitudinally and opened so as to show the folds of puckered mucous membrane.

1. The section through the portion whose lumen was occluded shows all four intestinal coats. The peritoneal coat was thickened and fibrous, in some places being 1 mm. in thickness. Numerous en-

gorged blood-vessels were present in this layer. There was no evidence of tubercle formation.

The muscular layers were separated by a thickened fibrous layer. Otherwise the appearance was essentially normal.

The mucosa and submucosa showed the most marked changes. The mucosa was apparently very redundant, and extended into the lumen in great papillæ, like exaggerated valvulæ conniventes. These were rather tortuous in their course and were so extensive as to nearly fill the lumen of the gut. The valvulæ were supported by a vascular connective tissue core derived from the submucosa. The muscle tissue did not enter into this formation at all. The epithelium and glands formed the usual villæ and were normal in appearance.

2. The sections through the coiled loops of intestine with patent lumen showed a muscularis essentially the same as in the portion just described. The mucosa and the submucosa while somewhat redundant were not nearly so much so as in the distal occluded portion. There were a few exaggerated valvulæ conniventes, but for the most part the mucosa closely approached the normal. The peritoneal coat, however, was thicker and in addition was connected with a loose fibrous tissue which bound together the adherent coils. Sections of the investing membrane were stained by the Ziehl-Neelson-Gabbett method and searched for tubercle bacilli—none were found.

*Diagnosis:*—1. Chronic plastic peritonitis.

2. Redundancy of intestinal mucosa.



## CHRONIC PERITONITIS AND CHRONIC MULTIPLE SEROSITIS

The condition was so unusual that it seemed desirable to have the literature searched for similar cases. Dr. Charles W. Lester has spent many hours in such search, mostly under the heading of "Chronic Peritonitis" and "Intestinal Obstruction." The case which most resembled this was reported by J. C. Muir.<sup>2</sup>

A girl, fifteen, who was operated upon for partial intestinal obstruction had a mass of tangled coils of intestine resected. The peritoneal coat of the gut was thickened and inflamed with many small tubercles present, which, however, did not

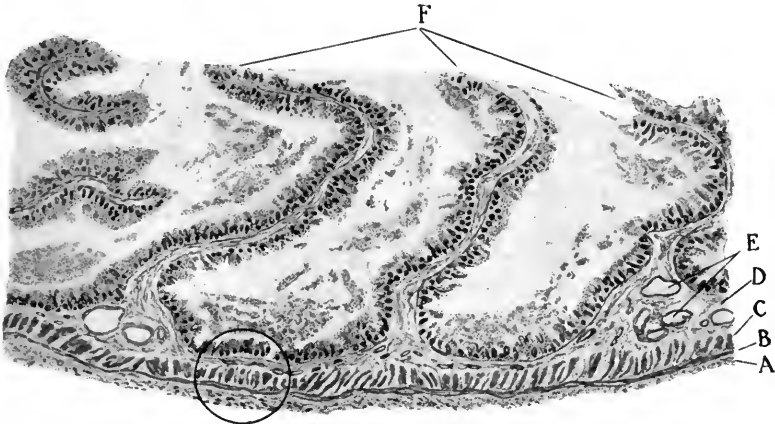


FIG. 5.—Longitudinal section of intestine (low power) showing investing membrane and the mucous membrane raised into transverse folds. A. Investing fibrous membrane. B. Longitudinal muscular coat. C. Circular muscular coat. D. Submucous layer. E. Blood-vessels in submucosa. F. Folds of mucous membrane.

have the appearance of tuberculous peritonitis. The adherent portion was resected to within about two inches of the ileocaecal valve, and an end-to-end anastomosis done. When the resected portion was straightened out it was estimated to be four feet in length. Ten weeks later she died of inanition, and at autopsy it was found that the remaining small intestine from the pylorus to the ileocaecal valve measured only 17 inches. The peritoneum was thickened and showed the spots which are described as tubercles, but they did not show tuberculosis on microscopical examination.

Osler and Nicholls have given the best pathological descriptions which we have found. Osler<sup>3</sup> in his *Principles and Practice of Medicine*, in the chapter on "Proliferative Peritonitis," in which he refers to polyserositis, states that "there are instances of chronic peritonitis in which the mesentery is so shortened by this proliferative change, that the intestines form a ball not larger than a cocoanut, situated in the middle line, and after the removal of the exudation, can be felt as a solid tumor. The intestinal wall is greatly thickened and the mucous membrane of the ileum is thrown into folds like the *valvulae conniventes*."

Adami and Nicholls<sup>4</sup> writing of chronic hyperplastic peritonitis state that "the mesentery may also be shortened so that the intestines lie in a ball close

to the vertebral column." "Occasionally there is no fluid exudate and the whole abdominal cavity is obliterated by adhesions of the visceral and parietal layers of peritoneal membrane."

Nicholls<sup>5</sup> also in an important paper before the American Medical Association calls "attention to a peculiar form of chronic peritonitis of progressive development, several instances of which have come under my notice recently." "The feature, however, that gives the affection its characteristic form is a peculiar overgrowth of fibrous tissue on the peritoneal membrane and the

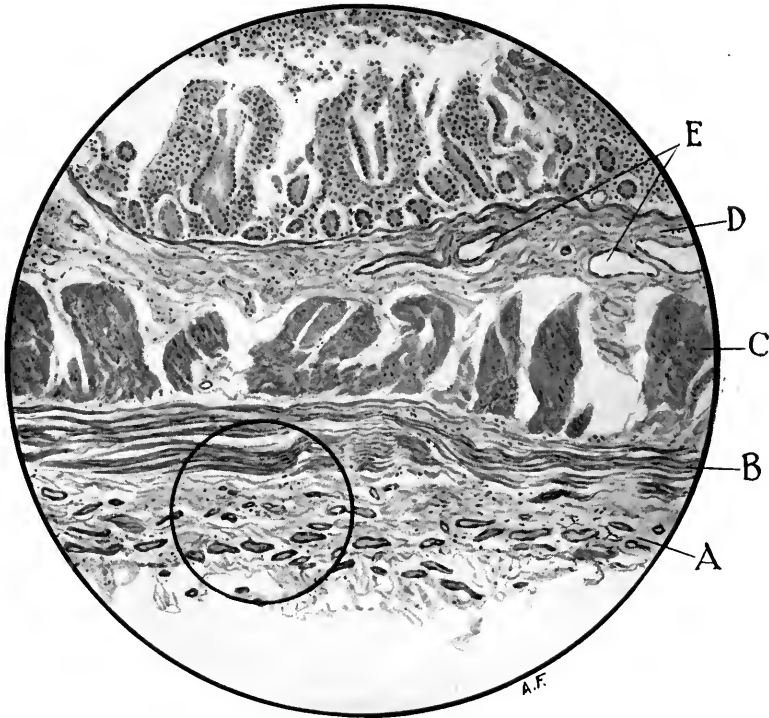


FIG. 6.—Higher magnification. Portion of intestinal wall shown within small circle in Fig. 5. Lettering same as in Fig. 5.

surfaces of the abdominal viscera, leading to induration and deformity. This fibrous tissue undergoes hyaline transformation so that plaques or continuous sheets of pearly white cartilaginous appearance are produced in various parts. The material in question has every feature of newly formed tissue, and the disease is both chronic and progressive. Shrinkage of the fibrous tissue takes place, hence one might correctly speak of the disease as chronic indurative peritonitis." The process is usually most marked about upper part of peritoneal cavity, liver, spleen, omentum, mesentery and may even extend to the pleural and pericardial cavities. "Although not new, the subject is one that has attracted but little attention in proportion to its importance. Ascites usually calls clinical attention to it, and somewhat resembles cirrhosis of the liver."

## CHRONIC PERITONITIS AND CHRONIC MULTIPLE SEROSITIS

The quotations from Osler, Adami and Nicholls are under the headings of some form of chronic peritonitis, but these authors in the same connection refer to a particular form of chronic peritonitis which is combined with inflammation of other serous membranes—especially the pleura and pericardium.

This form of inflammation has been distinctive enough to receive an especial name, in fact several names have been given to it. Nicholls<sup>6</sup> calls it multiple progressive hyaloserositis and definitely refers to it in the above quotation. The

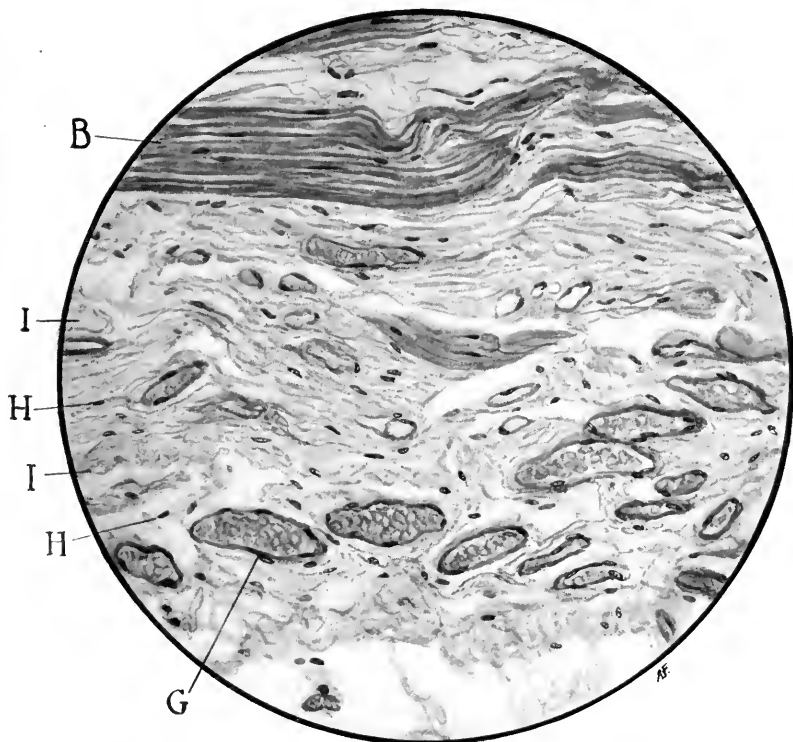


FIG. 7.—High magnification of the portion of fibrous investing membrane and longitudinal muscular coat shown within the small circle in Fig. 6. G. Blood-vessels in fibrous investing membrane. H. Small round cells. I. Fibrillar connective tissue.

subject is so intimately associated with our localized intestinal peritonitis that it should be described before proceeding further.

*Chronic Multiple Serositis.*—For at least three-quarters of a century surgical and medical literature has contained occasional references to this peculiar inflammation of the serous membranes, slow in its progress and leading to the formation of firm layers of fibrous tissue where the serous membranes had previously been and in certain localities to the adhesion of opposing serous surfaces.

The most common sites of this inflammation have been in the abdomen, especially in its upper part, in the pleural cavities and in the pericardium. The inflammation in the upper part of the abdomen has led to the adhesion of the

upper surface of the liver to the diaphragm and to the encasement of the liver and sometimes of the spleen in a "firm membrane which is composed of dense layers of connective tissue of a peculiar cartilaginous appearance." This fibrous encasement has been very firm. The inflammation in the pleura has led to the obliteration of part or all of one or both pleural cavities. The inflammation in the pericardium has caused the obliteration of the pericardial sac and in at least one instance (Kelly<sup>7</sup>) this process has gone to the stage of calcification so that a large section of the heart has been encased in a calcareous sheath.

Various names have been applied to this condition: Multiple progressive hyaloseritis (Nicholls); Chronic deforming perihepatitis; Zuckergussleber (icing liver) (Curschmann); Pericarditic pseudocirrhosis of the liver (Pick); multiple serositis (Kelly); Chronic multiple serositis (Mayo).

It is noted that the liver is referred to in many of these descriptive titles. The encasement of this organ in a dense layer of fibrous tissue is a prominent part of this remarkable pathological process. Pick's name is often used in describing the disease, although most observers ascribe less importance to the pericardial inflammation than he does. Curschmann's name is also frequently used in connection with the term "zuckergussleber."

Ascites has been the most prominent symptom. Many of the patients have had the ascitic fluid withdrawn time after time, 301 times in one instance. It is believed that many patients with supposed cirrhosis of the liver have really had this form of serositis. Symptoms referable to the heart and to the pleura have been next most common. The disease has been chronic and patients have gradually lost strength, the character of the symptoms depending on the site of the maximum inflammation.

The disease is a rare one, although Nicholls believes it not quite so rare as is generally supposed. Since ascites is the only symptom which has ordinarily led to a diagnosis, it is manifest that in the absence of ascites a considerable degree of inflammation could exist without the making of a diagnosis.

The resemblance between this condition and tuberculous peritonitis has caused considerable confusion, *e.g.*, Picchini,<sup>10</sup> in considering 110 cases under the term "Polionomenite," really refers to tuberculous peritonitis in most instances, and Concato<sup>11</sup> has reported on "Polionomenite Scofulosa." In 1903 Kelly,<sup>7</sup> in a masterly résumé of the subject, using the title "Multiple Serositis," tabulated 39 cases, at least eight of which were tuberculous. Nicholls states that "it is quite possible for the tubercle bacillus to produce a hyaline and productive fibrosis of the peritoneal membrane quite comparable to the simple form previously described" and quotes cases of Strajesko and Herrick for examples.

It is noteworthy that a disease which is characterized by the formation of extensive firm layers of fibrous tissue within the abdomen should interfere so little with the intestinal function, or at least that there should be so few reports of such interference. These fibrous layers are located mostly in

the upper part of the abdomen, but there seems to be no natural line of demarcation between that and the lower part of the abdomen. When there is so much of this fibrous tissue above we would naturally expect some below. As a matter of fact, we do find continual reference to such deposits, *e.g.*, Kelly states of his case, "The coils of intestine are united to one another and to the other intra-abdominal organs by moderately firm though friable fibrinous adhesions. In some places an exudate may be stripped off in thin layers." In his tabulation of 39 cases, there are many references to adhesions in various parts of the abdominal cavity. This year Mayo<sup>12</sup> called attention especially to the abdominal manifestation of "Chronic Multiple Serositis," in a paper read before the American Surgical Association. He referred to a patient who, in addition to the glistening white membrane in the upper part of the abdomen, also had the area of the small intestine "surrounded by a sheath of thickened peritoneum which bound the intestine down to the spine and resembled the flattened crown of a derby hat."

Nicholls describes a case in which in addition to the dense deposits in the pleura, pericardium and upper part of the abdomen, the parietal peritoneum was thickened, the mesentery was shortened and thickened, and "the intestines lay bunched along the vertebral column." The small intestines were short and the rugæ pronounced.

Jabez Jackson,<sup>13</sup> in his article on "Membranous Pericolitis" and allied conditions of the ileocæcal region, refers to a case which has bearing on the subject. "In one instance at least the membrane was a solid sheet of fibrous tissue, perfectly opaque and entirely obscuring the entire ascending colon and hepatic flexure which could not be recognized at all, until the membrane was divided and stripped away. Then we discovered a small, contracted, atrophied colon which we believed incapable of restored function. In this case we excised the entire ascending colon, including the hepatic flexure, and made an anastomosis between the ileum and transverse colon. Thus, entirely curing our patient."

Thus, in studying the reported cases we find that there is no lack of fibrous deposit about the intestines, but rather that the intestine shows a remarkable power of adjustment in continuing to function so long in spite of these constrictions. This is in marked contrast to the occasional result of local adhesions, for we all have seen angulation and complete obstruction caused by strands of fibrous tissue hardly thicker than knitting needles.

*Etiology.*—It is generally believed that the production of this fibrous membrane is due to the action of microorganisms of low virulence. Pneumococcus, B. Coli, B. Typhi, B. Tuberculosis, are the most likely offenders.

Without doubt many of the reported cases have been due to tuberculosis. But there is marked difference between this dense whitish cartilage-like membrane and the ordinary product of tuberculosis. Nicholls has described a case in which he believes the inflammation came from the gall-bladder and believes that this is not an uncommon source of the infection. He believes that the

lymph spaces are followed in the syndrome which comprises upper abdomen, pleuræ and pericardium.

It is also suggested that the formation of this membrane is due to toxins which are developed within the liver or within other abdominal organs. With our present knowledge it is manifestly impossible to prove such an hypothesis. We may well agree with the statement that Doctor Welch made in a discussion of Doctor Nicholls' paper to the effect that the "etiology is very obscure."

#### SUMMARY

1. There are a few recorded cases of chronic peritonitis which has agglutinated the small intestines into relatively small globular masses.
2. The intestinal mucous membrane becomes puckered into folds and eventually occludes the intestinal lumen.
3. The outside appearance of this mass gives little indication of the real length of intestine which it contains. Four-fifths of the small intestine may be contracted into a mass which apparently contains about one-fifth.
4. The cause of this peritonitis is not definitely known, but it is believed to be due to a low grade of infection or to the toxins of such infection. In certain instances the inflammation may have been tuberculous.
5. There are many points of resemblance between this process and inflammation known as chronic multiple serositis. Indeed, similar intestinal peritonitis has in certain instances formed a part of chronic multiple serositis.

#### BIBLIOGRAPHY

- <sup>1</sup> Porter, Miles F., and Welch, Wm. H.: (Transactions of the Section on Surgery and Anatomy, A. M. A., 1908, p. 202.)
- <sup>2</sup> Muir, J. C.: A Case of Extraordinary Shortness of Small Intestine. (British Medical Journal, 1914, (July 11) vol. ii, p. 73.)
- <sup>3</sup> Osler, Sir William: The Principles and Practice of Medicine. 8th Ed. p. 606.
- <sup>4</sup> Adami and Nicholls: Principles of Pathology, vol. ii, Systematic Pathology, 1909, p. 507.
- <sup>5</sup> Nicholls, Albert G.: Some Rare Forms of Chronic Peritonitis Associated with Productive Fibrosis and Hyaline Degeneration. Journal A. M. A., Mar. 14, 1903, vol. x1, p. 696.
- <sup>6</sup> Nicholls, Albert G.: On a Somewhat Rare Form of Chronic Inflammation of the Serous Membranes. (Multiple Progressive Hyalo Serositis) Studies Royal Victoria Hospital, Montreal, vol. i, No. 3, 1903.
- <sup>7</sup> Kelly, A. O. J.: On Multiple Serositis. Am. Jour. Med. Sc., 1903, vol. cxxv, p. 116-148.
- <sup>8</sup> Pick F.: Unter Chronische, unter dem Bilde der Lebercirrhose verlanfende pericarditis. Zeitsch. f. klin. Med., 1896, vol. xxix, pp. 385-410.
- <sup>9</sup> Curschmann, H.: Zur Differential-Diagnostik der mit ascites verbundenen Erkrankungen der leber und des Pfortadersystems. Deutsch. med. Wochenschr., 1884, vol. x, p. 164.
- <sup>10</sup> Picchini L.: La Polionomenite sub acute elenta. Il Morgagni, Milano, 1891, vol. xxxiii, pp. 608-653-725. 1892, vol. xxxiv, p. 69.
- <sup>11</sup> Concato: Gios Internat. della Scienze Medica 1881, Napoli N. S., pp. 1037-1053.
- <sup>12</sup> Mayo, W. J.: The Peritoneal Manifestation of Chronic Multiple Serositis, Concato Disease. ANNALS OF SURGERY, Oct., 1922, vol. lxxvi, p. 432, No. 4.
- <sup>13</sup> Jackson, Jabez N.: Membranous Pericolitis and Allied Conditions of the Ileocæcal Region. ANNALS OF SURGERY, vol. lviii, No. 3, p. 374, Mar., 1913.

## GASTRO-COLIC FISTULA

BY GEORGE P. PRATT, M.D.

OF OMAHA, NEBRASKA

FROM THE MEDICAL DEPARTMENT OF THE UNIVERSITY OF NEBRASKA

VOORHOEVE<sup>1</sup> found 105 cases of gastro-colic fistula reported in the literature up to the year 1912. The principal contributors of this study were Murchinson, who reported the first case in 1857, Bec,<sup>2</sup> Koch,<sup>3</sup> Port and Reizenstein,<sup>4</sup> Chavannaz,<sup>5</sup> Roger, and Menuet. Since then four cases have been added by Saucerotte;<sup>6</sup> four by Strauss;<sup>7</sup> three by Clairmont,<sup>8</sup> and one each by Burnham,<sup>9</sup> Axtell,<sup>10</sup> Haudeck,<sup>11</sup> Nahan,<sup>12</sup> Minkowski,<sup>13</sup> Neumann,<sup>14</sup> Groeschel,<sup>15</sup> Limbart,<sup>16</sup> Heinz,<sup>17</sup> Noordenbos<sup>18</sup> and Firth.<sup>19</sup> We are contributing one more case report of gastro-colic fistula which was due to carcinoma of the colon.

Inasmuch as Brinton observed eleven cases of this complication in 507 autopsies of gastric cancer, a frequency of 2.77 per cent., and since Dittrich in 106 carcinomata of the stomach found six gastro-colic fistulae, a frequency of 3.75 per cent., we feel that the condition occurs more frequently than the literature would lead one to believe. Many cases are not diagnosed and many not reported. Crummer has handed me a case report, he studied clinically and at autopsy in 1908, which was never reported. Bland Sutton, in his recent book "Tumors Innocent and Malignant," states "the close approximation of the transverse colon to the gall-bladder and to the stomach must be borne in mind, because a primary cancer of the gall-bladder sometimes implicates the adjacent section of the colon, and it is not uncommon for a cancerous growth in the colon to invade the stomach, and vice versa."

In considering the etiological factors of these fistulae, we have purposely omitted percentages. A study of the material at hand leads us to classify the causes in the order of frequency as follows: First, cancer; second, ulcer; third, following gastro-enterostomy; fourth, abscess in the peritoneal cavity; fifth, tuberculosis, and lastly, congenital anomalies. When due to cancer the primary lesions are more common in the stomach than in the colon.

The anatomical characteristics of the lesion are very variable according to its cause. Most of the time the autopsies disclose a more or less intimate connection between the stomach and the colon; the viscera are united on a fairly large surface. In other cases there is an intermediate cavity surrounded by adhesions through which the stomach and colon communicate. One finds all forms and sizes of fistulae. The communication may be direct or is made through a long and tortuous passage. The fistula may be small, only admitting a probe, or sometimes it is large enough to admit a fist. When due to cancer the communication is most common between the transverse colon and the stomach near the pylorus on the greater curvature. One case of double gastro-colic fistula was reported by Fabeck.

Abdominal pain and discomfort of a vague type, abdominal distention, offensive eructations, fecal vomiting, lientery, and the similarity of the vomitus and the stools should arouse suspicion of a gastro-colic fistula. Confirmation of this suspicion is not difficult and can be made by the following procedures: Loss of fluid by gastric lavage similar to that seen in some cases of hour-glass stomach; recovery of fecal material by lavage; recovery from the stomach of colored matter administered as an enema; barium meal with X-ray examination and a barium enema with the contrast meal found in stomach.

#### CASE REPORT

*History.*—Case No. 7155. O. C., male, married, age thirty-four, was admitted at the University Hospital, October 29, 1921, complaining of weakness, abdominal pain, an abdominal tumor, vomiting and diarrhoea. The weakness had gradually increased during the past year and there has been considerable loss of weight. Seven months ago the patient noticed a swelling in the abdomen, just above and to the left of the umbilicus. One month later this mass became extremely tender with more or less constant pain in the left hypochondrium. During the last three months the pain became exaggerated after eating, so that the more undigestible foods have been excluded from his diet. Vomiting at irregular intervals commenced ten days ago, increasing during the last five days. There were from five to six dark, watery stools a day. The stools and the vomitus, the patient states, are the same, describing both to be dark brown, of liquid consistency, with the same disagreeable odor.

*Past History.*—Negative.

*Family History.*—Negative.

*Physical Examination.*—The patient, a comparatively young man, appears quite ill, pale and markedly emaciated. The temperature is 99.2; pulse, 84; respiration, 20. The pupils are equal and active; mucous membranes of the nose and throat are pale; cervical glands not palpable; thyroid normal. The lungs are resonant throughout and the breath sounds normal. The apex beat is located in the fifth interspace, just inside the mid-clavicular line. No cardiac murmurs are heard and the heart sounds are clear. The pulse is regular but not strong. The abdomen is not distended and the walls are quite relaxed. There is a mass easily palpable, somewhat tender, about the size of a large orange, rather firm, irregular and nodular, just above and to the left of the umbilicus. This mass is freely movable in all directions. There is no expansive pulsation.

The temperature ranged before the operation between normal and 100° F. The respirations are normal and the pulse varied from 85 to 100. The blood-pressure is: Systolic 100, diastolic 58. The urine is acid in reaction; specific gravity 1.020; albumin negative; sugar negative and the microscopic examination negative for casts, pus and blood cells. The blood Wassermann is negative; hæmoglobin, 52 per cent.; red blood cells, 2,990,000; leucocytes, 11,200; differential normal. Stools are dark brown, containing much blood; microscopic and benzdine tests. The vomitus is dark brown in color, contains occult blood and has a fecal odor. There is an absence of free hydrochloric acid. The fæces and the vomitus are apparently the same material, and placed side by side one could not differentiate one from the other.

The X-ray examination shows barium passing immediately from the stomach to the transverse colon. (Fig. 1.)



## GASTRO-COLIC FISTULA

*Diagnosis.*—The condition was diagnosed clinically as an anastomosis between the stomach and colon associated with carcinoma.

*Operative Report.*—The patient was examined by Dr. A. F. Jonas and an exploratory laparotomy decided upon. The operation was made November 2, 1921, and reported as follows: "An incision was made about six inches in length

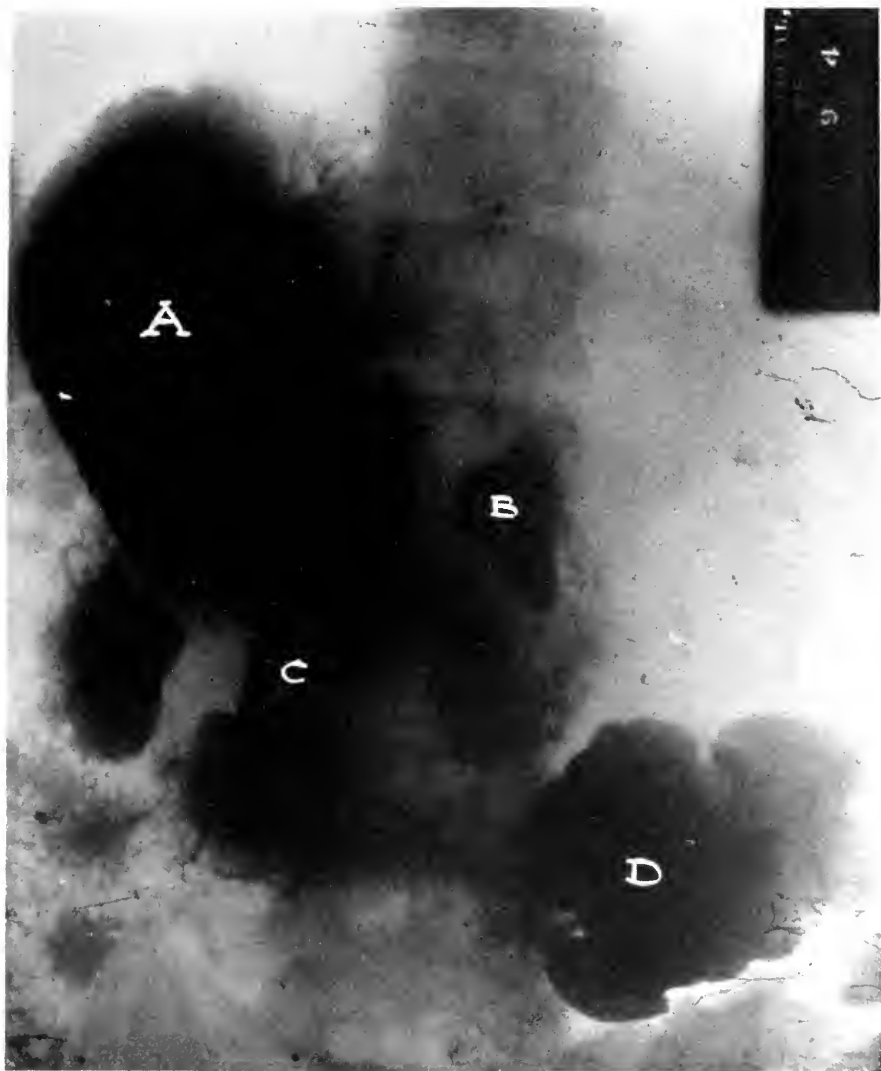


FIG. 1.—A. Stomach. B. Duodenal cap. C. Fistula. D. Transverse colon.

into the abdomen, through the right rectus muscle, above the level of the umbilicus. A freely movable tumor mass was found under the left costal arch, which proved to be a large carcinoma involving the entire circumference of the transverse colon and a small area of the greater curvature of the stomach by direct extension. A direct opening from the stomach into the transverse colon was demonstrated by invaginating the stomach with the index finger and inserting

it into the transverse colon. There was an extensive involvement of the retro-peritoneal glands all along the spine. Enlarged and hard glands were felt in the gastro-hepatic omentum. The pylorus and duodenum were free and unobstructed. Abdominal wall closed.

*Necropsy Report.*—The necropsy made by Doctor Keegan, November 26th, was without interest except for the abdominal findings which were recorded as follows: There is a healed recent surgical incision to the right of the middle line between the ensiform process and the umbilicus. The abdominal wall is thin. The peritoneum is smooth and glistening. There is no free fluid. The stomach is considerably distended and is found adherent to the transverse colon near the splenic flexure. On opening the stomach there is found an opening 3 to 4 cm. in



FIG. 2.—View from within the stomach showing opening of the fistula.

diameter communicating with the lumen of the transverse colon. (Fig. 2.) This opening is situated along the greater curvature of the stomach about six inches from the pylorus. Its edges are smooth, rounded and of moderate firmness. There is no ulceration evident nor extensive infiltration of the stomach wall. The pylorus is patent. The remaining mucosa of the stomach appears normal. On lifting the great omentum there are numerous adhesions to the tumor mass situated in the wall of the transverse colon. Numerous lymph-glands along the lesser and greater curvature of the stomach and the retroperitoneal glands are large, white, firm and nodular. On separation of the first portion of the jejunum from the transverse colon, where it had become more adherent, a small pocket of creamy pus and a communication into the lumen of the colon are found. The transverse colon was laid open and a rather soft, ulcerating nodular tumor is found involving the wall a distance of about four inches, extending through its entire circumference. There is no marked constriction of the lumen. The opening into the stomach observed previously was seen within the limits of the tumor. The small intestines are somewhat distended but appear quite normal.

## GASTRO-COLIC FISTULA

The appendix is small and retrocaecal. The large intestines and other regions appear normal. The liver is of normal size, extending to the costal margin. It is rather pale, of a reddish-yellow color, and serial sections showed no tumor metastases. The gall-bladder is normal and the bile ducts are patent. The spleen is of normal size and consistency. The pancreas is pale and nodular. The kidneys are of normal size. The capsule strips easily, leaving a smooth surface. The cortex is of normal thickness with distinct striations and clear differentiations from the medulla. The adrenals are negative. The retroperitoneal glands are markedly involved with tumor metastases, especially at the base of the mesentery of the small intestine.

Frozen section of the tumor of the colon revealed a massive epithelial cell infiltration with suggestive alveoli but very little differentiation of cells.

*Pathological Diagnosis.*—Carcinoma of the transverse colon with perforation into the stomach, also with a walled-off perforation into the peritoneal cavity; extensive retroperitoneal metastases.

### CONCLUSIONS

On account of the extreme annoyance of the accompanying symptoms and the disturbance of the digestive physiology with its inevitable fatal issue, an exploratory laparotomy is indicated. Surgery offers the only possibility of successful treatment. When carcinoma is the etiological factor, there is little hope that anything can be done, although Burnham reports a duodenocolic fistula in which the carcinomatous colon was resected and the opening in the duodenum closed with a favorable result. "Six months after the operation the patient was free from symptoms, enjoyed good health and had gained fifty pounds in weight." The gastro-colic fistula following gastro-enterostomy, due to ulcer or peritoneal infection, offers a better prognosis. There is always the possibility that the causative pathology may be removed and the openings in the stomach and colon successfully closed.

### BIBLIOGRAPHY

- <sup>1</sup> Voorhoeve, N.: Deut. Arch. f. k. Med., vol. cvi, p. 294, 1912.
- <sup>2</sup> Bec: These de Lyon, 1897.
- <sup>3</sup> Koch, P. H.: Archiv f. Verd. Krankheiten, vol. ix, p. 1, 1903.
- <sup>4</sup> Port u. Reizenstein: Mitt. a. d. Grenzgeb. Med. u. Chir., Bd. vol. xvii, 1907.
- <sup>5</sup> Chavannaz: Rev. de Gynec. et de Chir. Abd., vol. xi, p. 257, 1907.
- <sup>6</sup> Saucerotte, H.: Contrib. a l'etude des fistules gastro-colique. Montpellier, 1912, No. 74; 66 pp.
- <sup>7</sup> Strauss, H.: Berl. klin. Wchnschr., vol. lviii, p. 661, June 20, 1921.
- <sup>8</sup> Clairmont, P.: Wien. klin. Wchnschr., vol. xxxiii, p. 285, 1918.
- <sup>9</sup> Burnham, M. P.: Am. J. Roentgenol., vol. iv, p. 173, April, 1917.
- <sup>10</sup> Axtell: Am. J. Surg. N. Y., vol. xxiv, p. 190, 1910.
- <sup>11</sup> Haudeck, Martin: Wien. med. Wchnschr., 1912, vol. lxii, p. 3103.
- <sup>12</sup> Nahan, L.: Jour. de radiol. et d'electrol., vol. iii, p. 458, July-August, 1919.
- <sup>13</sup> Minkowski: Berl. klin. Wchnschr., vol. lvi, p. 956, 1919.
- <sup>14</sup> Neumann, Rudolph: Fortschr. a. d. Geb. d. Roentgenst., vol. xx, p. 398, 1913.
- <sup>15</sup> Groeschel, L. B.: Am. J. Roentgenol., vol. viii, p. 516, Sept., 1921.
- <sup>16</sup> Limbart, W.: Munch. med. Wchnschr. vol. lxvii, p. 1321, Nov. 12, 1920.
- <sup>17</sup> Heinz, A.: Deutsch. med. Wchnschr., vol. xlviii, p. 771, 1922.
- <sup>18</sup> Noordenbos, W.: Hederl. Tydschr. v. Geneesk., vol. lxvi, p. 2386, 1922.
- <sup>19</sup> Firth: Lancet, Lond., vol. i, p. 1061, May 15, 1920.

## SLIDING HERNIAS OF THE CÆCUM AND APPENDIX IN CHILDREN

BY VERNON C. DAVID, M.D.

OF CHICAGO, ILL.

THERE are many explanations offered to clarify the underlying causes of sliding hernia in which a portion of the large bowel, as the ascending colon or sigmoid, makes up a part or major portion of the sac of the hernia by reason of the small extraperitoneal portion of the bowel having descended into the scrotum, carrying with it the larger peritoneal portion of the bowel.

While hernias containing cæcum and appendix in their sacs are not very uncommon, real sliding hernias are rarely seen in children. Some of the factors underlying the development of sliding hernias of the cæcum and appendix in children will be considered.

*Incidence of Cæcal Hernia and Sliding Hernia.*—Coley in 2200 hernias found the cæcum alone in the sac in eighteen, the appendix alone in ten and the cæcum and appendix together in seven.

Judd<sup>1</sup> found fourteen sliding hernias in 1652 hernias and of these six were of the cæcum and on the right side.

Hilgenreiner,<sup>2</sup> in describing rare hernias occurring in the Wölfer clinic over a period of fifteen years, said they had observed twenty-two hernias of the cæcum, of which eight were of the sliding variety, in a total of 2238 hernias operated upon.

Baumgartner<sup>3</sup> collected 159 sliding hernias from the literature. Eighty-five were right sided. Four were left inguinal hernias containing the cæcum.

Hildebrand,<sup>4</sup> in an exhaustive study of the material in 1892, collected one hundred twenty-eight cases of hernia of the cæcum, eighty of which were right inguinal hernia, eighteen were left inguinal hernia and eleven were right femoral hernia. He found sixteen instances where the cæcum was present in right inguinal hernia in children. Of these, two were in the fœtus at the eighth month, two were in children over a year old and twelve were in children during the first year of life. The appendix was attached to the sac and testis in three cases. The ascending colon was adherent to the sac in two instances, but the cæcum was free of the sac in all of the cases.

The two most discussed factors in the causation of sliding hernia in children are the rotation of the cæcum and the descent of the testes during fetal life.

*Rotation of the Cæcum and Ascending Colon.*—The cæcum develops as a small diverticulum from the large bowel as early as the fifth week of fetal life, before axial rotation of the gut has taken place and while there is still a common mesentery. Axial rotation of the bowel now takes place and the cæcum, which is entirely covered with peritoneum, is found under the liver with the large bowel which is eventually to become the ascending colon. The large bowel now descends to the right and the lateral peritoneal aspect

of the ascending colon comes in contact with the posterior parietal peritoneum and fusion occurs between the two layers. The posterior aspect of the ascending colon thus becomes devoid of peritoneum, loses its mesentery and is fixed to the posterior abdominal wall. The cæcum and appendix remain covered with peritoneum but do not possess a true mesentery. According to McMurrick,<sup>5</sup> the fusion of the posterior parietal peritoneum and the lateral peritoneal covering of the ascending colon is incomplete in one-fourth to one-third of the cases examined by him. An incomplete fixation of the ascending colon, therefore, results.

Hildebrand<sup>4</sup> has observed in children that the ascending colon may be practically free and covered with peritoneum, though in adults this condition is more rarely found. It is usually stated that the appendix and cæcum reach their normal position in the abdomen about the seventh to eighth month of fetal life, although Treves<sup>6</sup> maintains that the cæcum, having reached its position underneath the liver during axial rotation of the bowel, remains there until the fourth month after birth, at which time the cæcum descends to the right iliac fossa. The

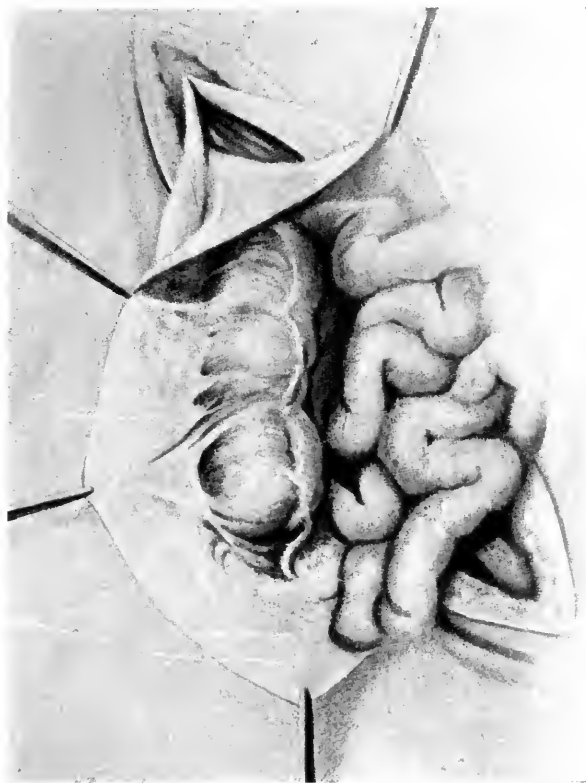


FIG. 1.—Sliding hernia of cæcum and appendix. (After Sprengel.)

finding of the cæcum in the patent vaginal process of peritoneum at the eighth month of fetal life makes the view of Treves somewhat doubtful.

While the cæcum is anchored in position by peritoneal folds described by Scarpa and Tuffier,<sup>7</sup> it has considerable freedom of motion which is dependent to a great degree on the fixation of the ascending colon to the posterior abdominal wall. The cæcum usually lies a little mesial to the middle of Poupart's ligament.

*Descent of the Testicles.*—Developing in the lumbar region, the testicles descend to the inner side of the anterior abdominal wall near the internal ring at about the fifth month of fetal life.

The vaginal process of peritoneum is now formed and this descends into

the scrotum. The gubernaculum testis is attached to the bottom of this peritoneal process. Due to lack of further growth of the gubernaculi, the testes are drawn between the wall of the vaginal process of peritoneum and the infundibuliform fascia at about the eighth month of fetal life and at birth are usually found in the scrotum. It is important to note that the vaginal process of peritoneum is formed and descends into the scrotum before the testicles leave the inguinal canal. The upper part of the vaginal process is usually occluded at birth, the lower end forming the tunica vaginalis testis. A

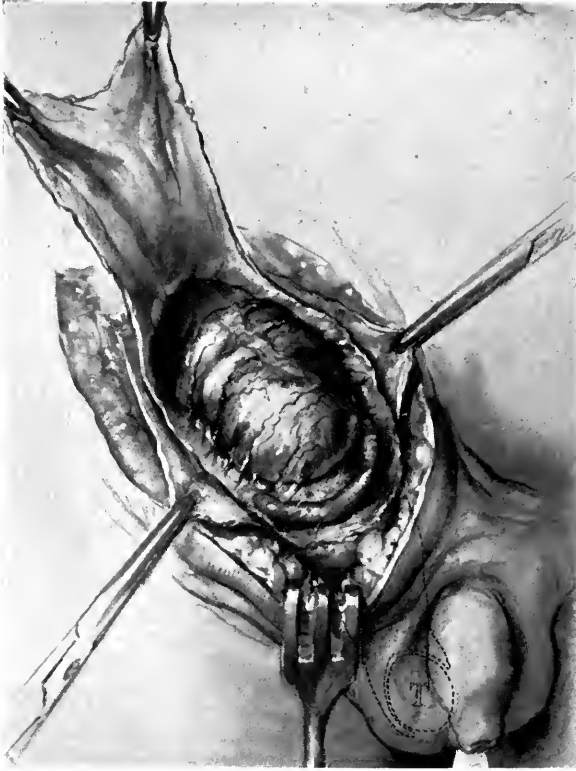


FIG. 2.—Sac divided into an anterior and posterior portion.

persistence of the vaginal process in its entirety forms the sac of the congenital type of hernia.

The embryological development of the ascending colon and the descent of the testicles have been particularly considered because of the belief that adhesions forming between the testicle and the cæcum and appendix during fetal life are responsible for the appearance of the cæcum and appendix in the hernial sac. Lockwood<sup>8</sup> describes a peritoneal fold, the plica vascularis, which runs from the mesorchium of the testicle along the posterior abdominal wall to

end in the cæcum, appendix or mesentery. Persistence of this fold is a developmental defect. He suggests that in descent of the testicle, the cæcum is pulled down into the scrotum by this fold. He was able to demonstrate gubernaculum fibres passing into the plica vascularis in one child. Other observations have been made of adhesions between the cæcum and testicle, where the cæcum was in the hernial sac, as well as in cases of non-descent of the testicle.

Hutchinson and Piesol were unable to trace any direct connection between the plica vascularis and cæcum. Waldeyer<sup>9</sup> does not believe that there is a relation between the two. While many observations of adhesions between the

cæcum and testicle have been made, in most of them the testicles had already descended and it was difficult to say whether the adhesions had developed before or after descent of the testicles.

There are further objections to this theory. The vaginal process of peritoneum, which is the potential hernial sac, has already reached the scrotum before the testicle descends between it and the infundibuliform fascia. At the seventh month of fetal life, the testicles are just about to enter the inguinal canal. In order for the cæcum to become a sliding hernia and be incorporated in the sac of the hernia, which is already potentially present in the vaginal process of the peritoneum, it must be assumed that sufficient pull is exerted by the testicle in its descent to drag down not only the cæcum but also that part of the posterior parietal peritoneum which is between the adherent testicle and cæcum. This would mean that a portion of the posterior parietal peritoneum would be displaced from a position near the internal ring to the bottom of the scrotum where the testicle rests. It would seem more logical to assume that non-descent of the testicle would occur if no other factor



FIG. 3.—Posterior portion of sac lifted from its bed.

than these adhesions were active in the causation of the sliding hernia. Ransahoff also objects to the influence of the testicle in the formation of these herniæ because the testicle is separated from the gut by peritoneum and is the case of the ascending colon by a double fixed layer of mesocolon.

In the three cases of sliding hernia of the cæcum in children to be reported in this paper, there were no adhesions between the bowel and the testicle and no gross evidence of a plica vascularis was present.

As has been pointed out from the embryological side, the mesentery of the ascending colon may persist to a greater or less extent and this is especially true in children. This would allow an abnormal position of the cæcum to

obtain which in an extreme instance would allow the cæcum to be present in a left-sided hernia. While these deviations from normal explain the entrance of cæcum and appendix into hernial sacs in children, it does not clarify the conditions found in sliding hernia, *viz.*, that the bowel wall be incorporated in the hernial sac as part of the sac. There are several possible explanations to be given. First, and of doubtful importance, is the action of a fetal peritonitis which by formation of an exudate would so involve the sac and the prolapsed cæcum that in its resolution the two would become

firmly united. If this condition were present it would seem logical to expect other evidence of the peritonitis than the mere union of the cæcum and hernial sac. The most plausible explanation to me is the possibility of fusion of the peritoneal surface of the cæcum, which has found its way into the hernial sac, to the peritoneum of the vaginal process in the same way that the lateral surface of the ascending colon and posterior parietal peritoneum become fused when the mesentery of the ascending colon is lost. This would assume that by an abnormal position of the cæcum in the vaginal process of peritoneum, a fusion of the

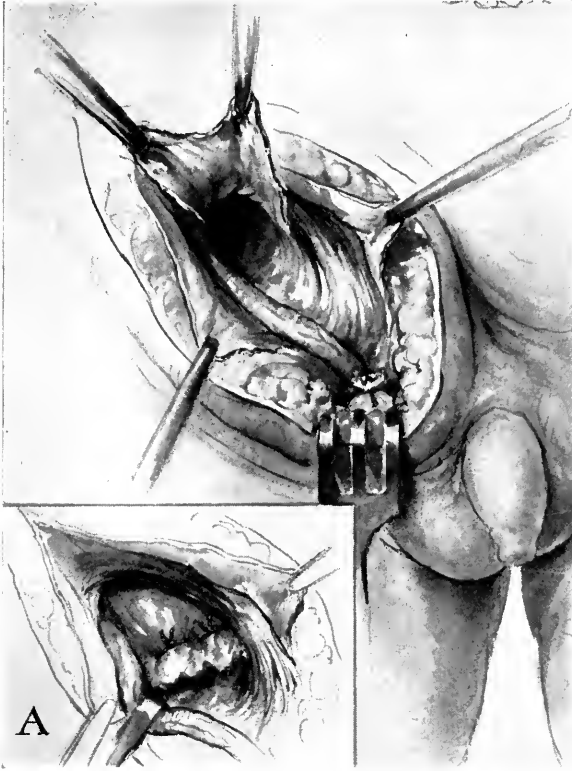


FIG. 4.—Posterior portion of sac reduced into abdomen. A—anterior portion of sac sutured over internal ring.

two apposing layers of peritoneum took place, so that the cæcum, which is normally free and devoid of mesentery, became part of the sac of a congenital hernia. A third explanation of the presence of the cæcum in a sliding hernia in childhood is found in the possibility of the fusion of the peritoneal surface of the cæcum to that part of the parietal peritoneum which later will become the vaginal process of peritoneum about the sixth to seventh month of fetal life and consequent descent of the cæcum into the hernial sac in this way.

Moschcowitz<sup>10</sup> maintains that bowel completely covered with peritoneum, as cæcum, cannot become part of a sliding hernia. This must be but a



## SLIDING HERNIAS OF CÆCUM IN CHILDREN

matter of definition, for it is certain that the cæcum and appendix were incorporated in the sac of the hernias to be described and were part and parcel of the sac.

CASE I.—James P., boy, sixteen months of age. His mother discovered a swelling at the right inguinal region when he was eight weeks old. This swelling has increased in size and is irreducible.

*Examination.*—A right inguinal hernia reaching into the scrotum is present. The swelling is about the size of a pear and is only partially reducible. Owing to the danger of strangulation in a large irreducible hernia, operation was decided upon.

*Operation.*—July 7, 1922, Cook County Hospital, by Doctor David. Ether anæsthesia. Upon opening the anterior portion of the sac, several loops of small bowel as well as the cæcum and appendix were seen. The sac was a congenital one, connecting freely with the tunica vaginalis testis. The small bowel was reduced easily, leaving the cæcum and appendix, which formed the posterior wall of the sac. The cæcum extended well below the external inguinal ring and the appendix, which was six centimetres long, curled around the posterior scrotal surface of the sac, and comprised part of the sac in that it could only be removed from the sac by cutting the wall of the sac where it was attached. Neither the cæcum nor the appendix was connected with the testicle, which was in the normal position in the scrotum, by adhesions or by any vascular pedicle which might correspond to the plica vascularis (Fig. 1). From the inner wall of the sac contiguous to the cæcum, many fine blood-vessels ran over the convexity of the cæcum and appendix. The mesenteriolum of the appendix was not apparent. A slight vascular veil covered several portions of the appendix.

The hernial sac was divided transversely between the appendix and the testicle and the testicular portion closed by a purse-string, thus reëstablishing the tunica vaginalis testis. The appendix was removed in the usual way, removing the sac wall under the appendix. The sac was divided longitudinally (Fig. 2), leaving a posterior portion made up of cæcum and anterior portion of peritoneum. This longitudinal division was carried up to the internal ring. The posterior cæcal portion was now raised up from the cord and separated from the surrounding soft parts up to the internal ring (Fig. 3). The cæcum with loose contiguous edges of sac was now reduced (Fig. 4) into the abdomen through the internal ring and the anterior peritoneal portion was cut away, leaving only enough to imbricate and sew over the posterior denuded area of the reduced posterior half of the sac which was cæcum.

This same technic has been used in principle in sliding herniæ of adults. The literature shows that Henverswyn<sup>11</sup> is credited with first forming a mesentery for the cæcum from the posterior wall of the sac in 1893. Tuffier,<sup>7</sup> Wier,<sup>12</sup> Hotchkiss,<sup>13</sup> Walton,<sup>14</sup> Sprengel<sup>15</sup> have suggested the method anew or have modified the technic in some few details. In nearly all of these modifications, the edges of the sac contiguous to the bowel, comprising the posterior wall of the sac, were sutured behind the bowel before its return to the abdomen.

CASE II.—Boy, six years old. Right inguinal hernia present since infancy. Testicle in scrotum. Hernia irreducible. Appendix was palpated in the sac before operation. Operative findings and technic almost identical with Case I. There were no adhesions between the testicle and bowel nor was there any evidence of a vascular connection.

CASE III.—Boy, aged fourteen months. No history was obtainable. The cæcum alone was present in the sac. The bowel was not adherent to the testicle nor was there a vascular connection between the bowel and testicle. The reduction of the hernia was accomplished by the same technic as used in Case I.

BIBLIOGRAPHY

- <sup>1</sup> Judd: Mayo Clinic Paper, 1909.
- <sup>2</sup> Hilgenreiner: *Beitrag z. klin. Chir.*, 1910, vol. lxi, p. 333.
- <sup>3</sup> Baumgartner: *Les hernies par glissement au gros intestine*. Paris, 1905
- <sup>4</sup> Hildebrand: *Deutsch. Zeit. f. Chir.*, vol. xxxiii, S. 182, 1892. See for Tuffier reference.
- <sup>5</sup> McMurrick, J. R.: *Development of the Human Body*. 1902.
- <sup>6</sup> Treves, F.: *Brit. Med. Jour.*, vol. i, 1885.
- <sup>7</sup> Tuffier: Ref. to Hildebrand for quotation.
- <sup>8</sup> Lockwood: *Morbid Anat., Path. and Treat. of Hernia*. 1899.
- <sup>9</sup> Waldeyer: *Virch. Arch.* 1874.
- <sup>10</sup> Moschcowitz: *ANNALS OF SURGERY*, 1914, vol. lix, p. 610.
- <sup>11</sup> Henverswyn: *Jour. des Sci. Med. d'Lille*, 1893, p. 121.
- <sup>12</sup> Wier, R.: *Med. Record*, February 24, 1900.
- <sup>13</sup> Hotchkiss: *ANNALS OF SURGERY*, vol. 1, 1909, p. 410.
- <sup>14</sup> Walton: *ANNALS OF SURGERY*, vol. lvii, p. 86.
- <sup>15</sup> Sprengel: *Arch. f. klin. Chir.*, 1911, vol. xcv, p. 702

## MASSIVE VENTRAL HERNIA WITH FECAL FISTULA

BY HORACE S. VILLARS, M.D.

MAJOR MEDICAL CORPS, U. S. ARMY

WALTER REED GENERAL HOSPITAL, WASHINGTON, D. C.

THE following case of post-operative ventral hernia is reported because it is believed to be of unusual interest on account of its great size and the attending complications that existed at the time of operation.

The patient, admitted September 17, 1921, was a man thirty-two years of age, of the heavy, thick-chested and short-necked type, weighing two hundred and ten pounds. His occupation had been that of a steel sash erector prior to March, 1918, the beginning of his present trouble, and physically he was well adapted for such work. The physical examination showed his general condition to be excellent except for the lesion which caused him to seek admission to this hospital. This was an enormous ventral hernia accompanied by complete relaxation of all supporting structures on the right side of the abdomen and further complicated by a discharging fecal fistula at the lower pole of an old right rectus incision. The hernial protrusion (as shown in Fig. 1) was pendulous and, without exaggeration, as large as a man's head. The skin covering it was smooth, tense and shiny, and so thinned in the area of the old scar that peristalsis was as easily seen as felt. When the patient coughed, the whole mass seemed almost erectile, so visible was the impulse. There was a complete absence of subcutaneous fat over the area of the hernia, although on the left side of the abdomen, as over the remainder of his body, there was a superabundance of this tissue.

The material history of the development of this hernia began with an operation in another hospital for acute appendicitis March 3, 1918, in which a right rectus incision was used and closed without drainage by a continuous suture. On the fifth day this suture was removed, too soon in this instance, for the patient states the whole wound gaped wide so that the surgeon was obliged to use his hands to keep the intestines from protruding and adhesive strips were necessary to approximate the skin edges. The union of these tissues was complete in twenty days, but they served only as a covering for a post-operative hernia. The patient was held in that hospital until June 24, 1918, when a secondary operation was performed to repair this hernia. Five days later the wound broke down and a fecal fistula was established in the lower pole of the incision. This fistula persisted, and in September the man was discharged with a draining wound and a large ventral hernia. From that time until March, 1920, there was no change in his condition. The fistula and hernia remained as they were at the time of his discharge. At this time he went to another hospital in a western city and without any preliminary dieting or treatment was operated a second time for the repair of his hernia. In this operation, according to the statement of the surgeon, the sheaths of both recti were transplanted in an effort to reinforce closure. This attempt also was unsuccessful and the patient again was discharged, still in possession of both ventral hernia and fecal fistula. He then went to his home and remained there, enabled to move about by the use of an abdominal belt, until September 17, 1921, when he was admitted to Walter Reed U. S. Army General Hospital.

In brief, in the preceding three and a half years this patient had had his tissue resistance lowered by three major operations and by long-standing infection inci-



FIG. 1.—The ventral hernia before operation.

## MASSIVE VENTRAL HERNIA

dent to the fecal fistula; general adipose tissue had increased during his enforced idleness and, in all probability, the structures necessary for an adequate repair were rendered useless by the operations mentioned—an interesting but hardly an encouraging case to undertake to correct.

On his admission here he was put at once on a very restricted diet for the purpose of reducing his weight. At the same time his abdomen was firmly strapped with broad bands of adhesive tape in an attempt to force back and to hold the hernial contents—the small intestines—in their normal habitat. This strapping served the double purpose of an abdominal support and, more important, surgically, provided a means for the intestinal tract to become accustomed to the increased abdominal tension which would naturally follow any curative operation. At the end of eight weeks, November 3, 1921, this had been accomplished. The patient had been reduced twenty-five pounds in weight and was considered ready for operation.

Using ether as the anæsthetic of choice, the operation was performed by Lieutenant Colonel William L. Keller, Medical Corps. First a large elliptical flap of skin including the old scar and the external opening of the fecal fistula was excised. It was found that almost the entire small intestine was in the hernial sac and firmly adherent to the anterior wall, which was formed by the skin alone, the parietal peritoneum not being recognizable in that area. After a very difficult dissection, the intestines were freed from their skin covering and numerous constricting bands of adhesions between loops of the small bowel cut. Resection of the ileum was necessary at the point of the fecal fistula and again at a point above where it was impossible to relieve the constriction by dissection. A Bonnie tube was then introduced into the ileum just above this higher resection, as a precaution against distention, and secured by two purse-string sutures.

This much accomplished, closure of the wall was the next step. It was desired to cover the intestines with omentum as an aid in preventing the recurrence of adhesions, but that, too, had been used up in the previous operations. The vertical borders of what remained of the rectus abdominis and the oblique and transversalis muscles were dissected free, and closure of the muscular plane made by the lateral overlapping method, the Bonnie tube being brought out obliquely to avoid constriction. The skin incision was then closed with interrupted silkworm sutures, using rubber tissue drainage at the upper and lower poles and at the centre. The Bonnie tube was drawn out through a stab incision about three-quarters of an inch below and lateral to the centre of the skin incision. The abdomen was then tightly strapped, from pubis to sternum, with long strips of one-inch adhesive so as to take as much tension as was possible from the deep sutures. A gauze dressing was applied over the adhesive and the patient put to bed in the Fowler's position.

The technic of the operation completed, success was then dependent upon the post-operative procedures. The large quantities of gas that passed out through the Bonnie tube more than justified its use, and because of it the patient was remarkably free from discomfort due to gaseous distention. It was removed on the seventh day after operation, and superficial drainage instituted through the stab incision to care for a colon infection that had been expected in tissues which had suffered such infection for over three years. This complication was treated by irrigations with Dakin's solution twice daily and was soon cleared up. At no time was there any fecal discharge. There was considerable sloughing of subcutaneous tissues, as was to be expected where such extensive dissection had been carried out, but this gradually decreased and the entire wound healed without further accident, the muscular layer firmly united, forming an apparently adequate abdominal wall. Tension and support were maintained throughout convalescence by long adhesive straps which when necessary were removed one at a time from



FIG. 2.—Result of operation for the cure of ventral hernia.

## MASSIVE VENTRAL HERNIA

above downwards, each strap being replaced by a fresh one before the next was removed.

During the first week of his post-operative period, the patient developed a left lobar pneumonia, but this was successfully combated and no other complication was encountered during his entire convalescence.

On the first of February, 1922, the adhesive strips were replaced by a canvas belt and the patient allowed to be up in a wheel chair. He left the hospital on the first of March, 1922, his wound of operation firmly healed, the abdominal wall apparently adequate in its support, and with a cosmetic result that is shown in the accompanying photograph (Fig. 2).

Ten months after his operation he reported that his condition was excellent and that there were no signs of a recurrence of the hernia.

**DOUBLE KIDNEY\***  
BY DANIEL N. EISENDRATH, M.D.  
OF CHICAGO, ILL.

*Definition.*—There is still much confusion in the nomenclature of renal anomalies. The term unilateral fused kidney is applied by many to two quite different anomalies, namely: to those in which both kidneys lie on the same side of the body as well as to the cases in which there is a reduplication of the renal pelvis on one or both sides.

In the former (both kidneys on, or almost all on, the same side), the term crossed ectopia is the less confusing one to employ, because the lower of the two kidneys represents the congenitally displaced or ectopic kidney of the opposite side. The more or less complete fusion in crossed ectopia is the result of a displacement of one kidney during embryonic life and not that of a reduplication of the embryonic ureteral bud with the formation of a permanent kidney around the cranial end of each of the two ureters which may arise



FIG. 1.—Pyelonephritis in lower pole of a kidney, having two pelvises, and two ureters, but no separation of the parenchyma. (Author's case.)

from the same ureteral bud. This latter condition is better referred to either as reduplication of the ureters and renal pelvises, or better still from the clinical standpoint as double kidney.

---

\* Read before the Chicago Surgical Society, December 1, 1922.



## DOUBLE KIDNEY

Horseshoe kidney exists in all possible variations of a basic type in which one-half lies on either side of the spine. The two halves of a horseshoe kidney are always connected by an isthmus which varies from a mere narrow band of fibrous tissue or parenchyma to such a wide fusion of the two halves along their mesial borders that one finds simply a single mass in which the separate halves are no longer distinguishable. Although one-half of a horseshoe kidney may be considerably higher than the other and one-half may lie much nearer the median line of the spine than the other half, the two never lie entirely on one side as is the case in crossed ectopia. As will be seen later,

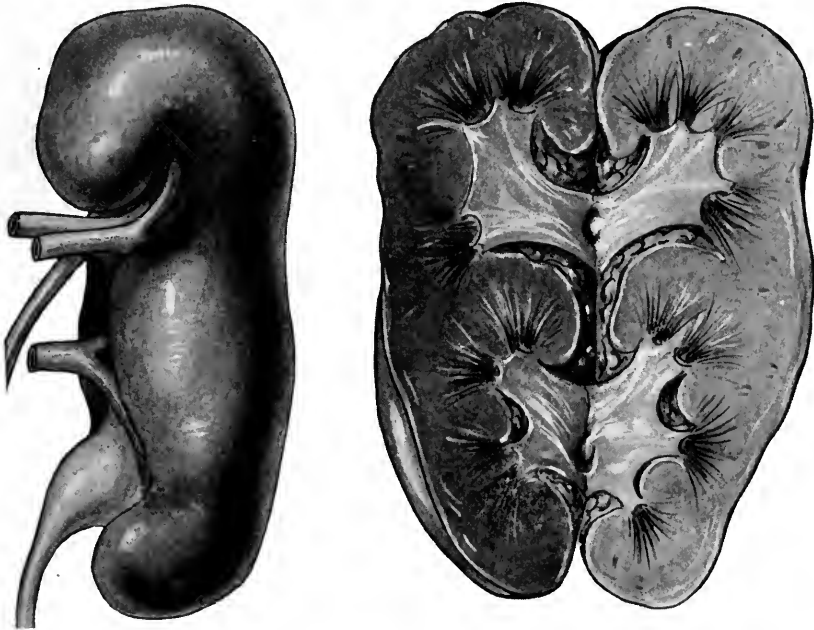


FIG. 2.—Double kidney with no separation of parenchyma and one artery and vein supplying upper half. There is no artery for lower half, only one vein returning blood from this half. (Wimmer, Case 2.)

cases have been described of reduplication of the pelves in horseshoe kidney (Fig. 12), but it is less confusing to term this a combination of horseshoe and double kidney.

By supernumerary kidney we mean a third complete kidney neither connected with the normally placed and developed organ of the side on which it lies nor with the similarly normally placed and developed kidney of the opposite side. Very few recorded cases bear close scrutiny, because some at least are really instances of true double kidney with complete separation of the two halves.

By double kidney then we mean cases in which there is reduplication of the renal pelvis on one or both sides in association with a similar condition of the ureters on one or both sides. Many most excellent contributions like those of Delmas,<sup>1</sup> Mertz<sup>2</sup> and Papin<sup>3</sup> approach this question from a

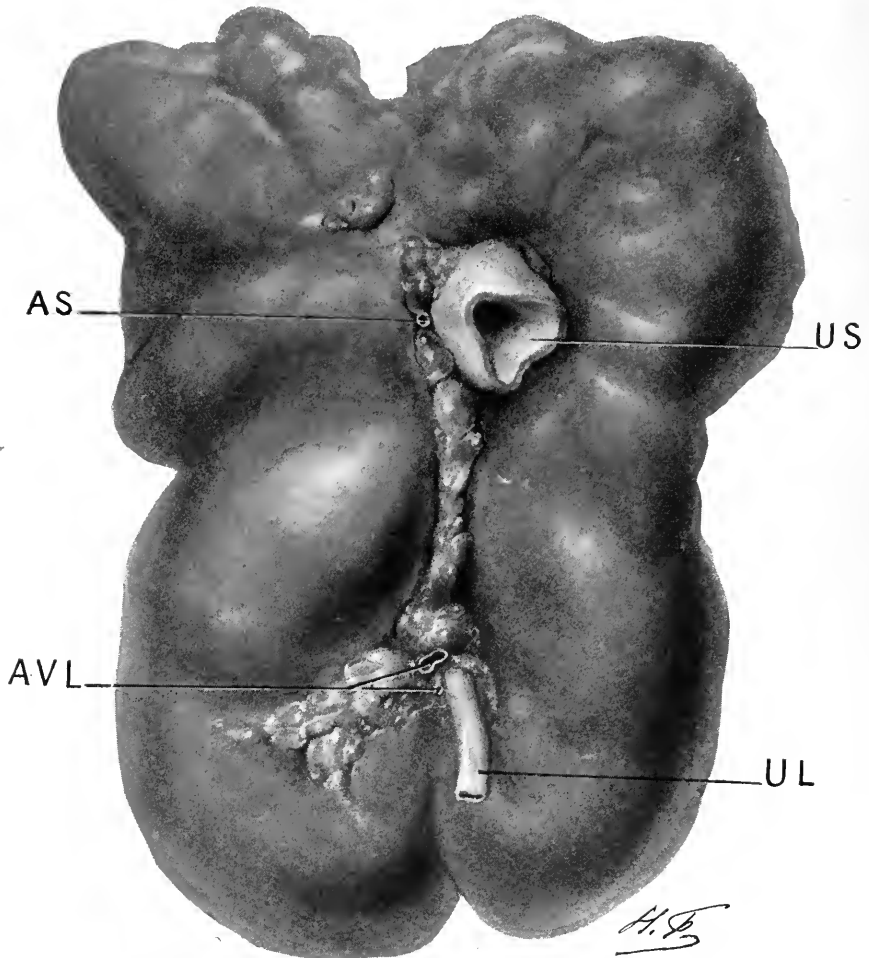


FIG. 3.—Exterior of double kidney shown in Fig. 4 (Marion). The two halves have a separate blood supply. (See A. S. and A. V. L.) U. S. and U. L.—upper and lower ureters. ■

DOUBLE KIDNEY

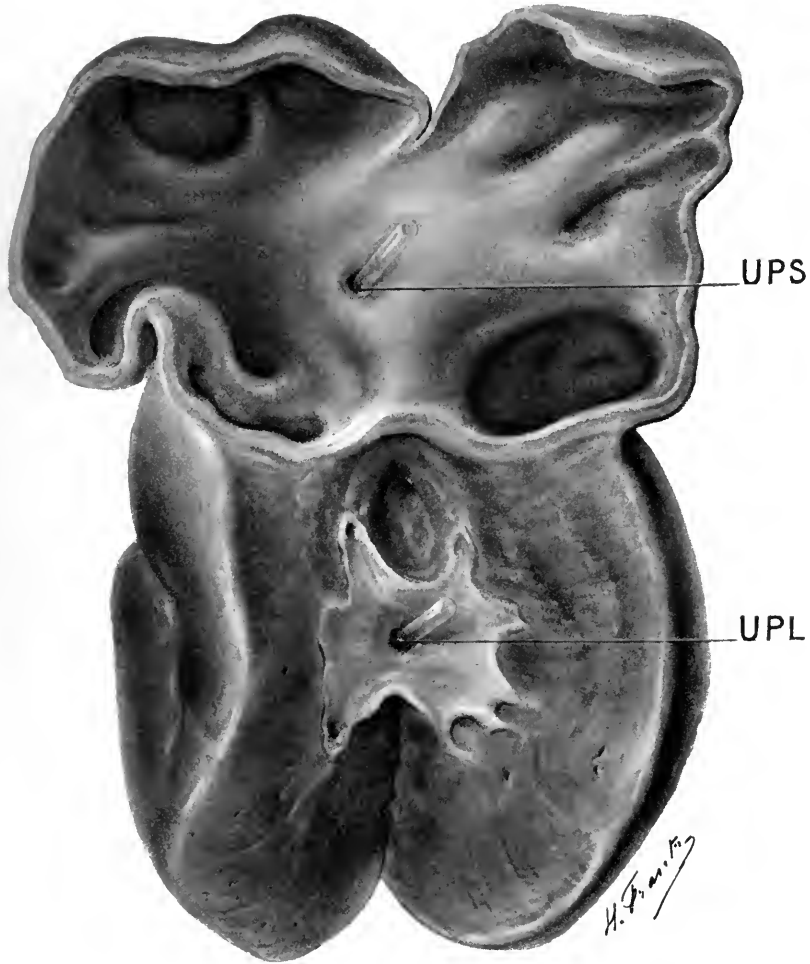


FIG. 4.—Sectional view of case of hydronephrosis of double kidney shown in Fig. 3 (Marion).  
Note ease with which the two halves can be separated.

different angle than is the case in this paper. Clinically the reduplication of the ureters (double ureter) is subordinate in importance to the reduplication of the renal pelvis (double kidney), because pathological changes in the

ureters are, as is true of single ureters, usually secondary to those in the renal pelvis and corresponding halves of the parenchyma. For this reason when double kidney is referred to in this paper, it is always understood that there is an accompanying anomaly in the form of a double ureter. Neither Young and Davis<sup>4</sup> nor the writer have been able to find a clinical case in which there was reduplication of the ureters (double ureters) associated with a single renal pelvis, that is, where there were two ureteral orifices on one or both sides, the ureters corresponding to these uniting to form a single ureter and ending in a single renal pelvis.

*Frequency.—(a)*

Frequency in general: Nearly all of the contributions to

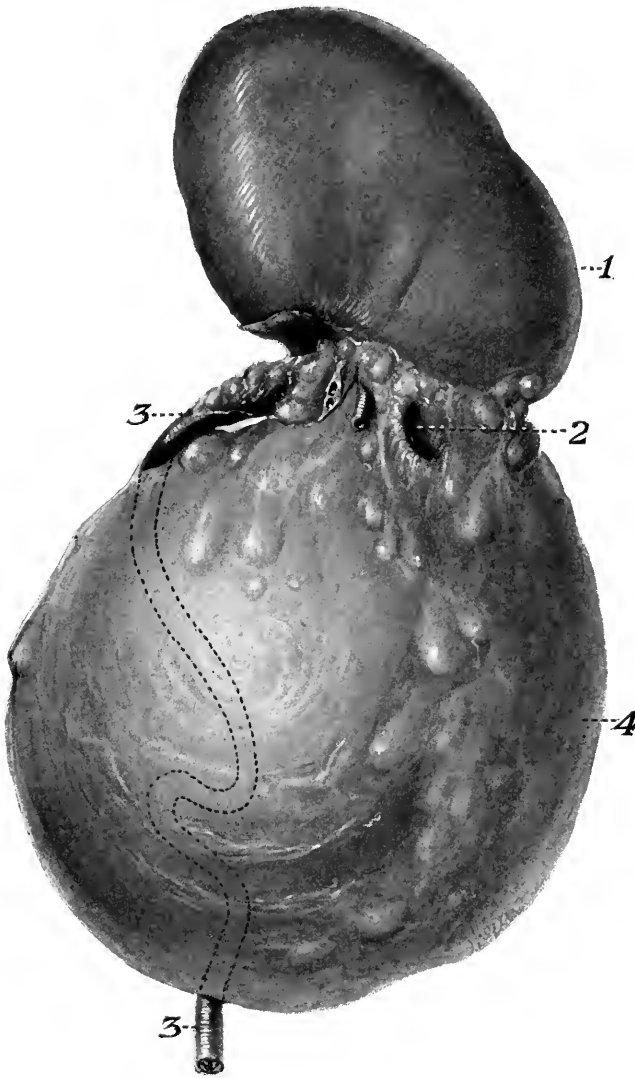


FIG. 5.—Exterior of same kidney shown in Fig. 6 with well marked groove separating the two halves (1 and 4). Note course of ureter (3) from upper half along posterior surface of hydronephrotic lower half. Ureteral (2) opening of lower half was at upper end of dilated pelvis. Blood supply to centre only. (Own case.)

this subject state the frequency with which reduplication of the ureters is found. There is no recorded case in which there was a reduplication of the ureters and a union at some higher point so as to end in a single pelvis. Hence, the statistics as to relative frequency of reduplication of the ureters

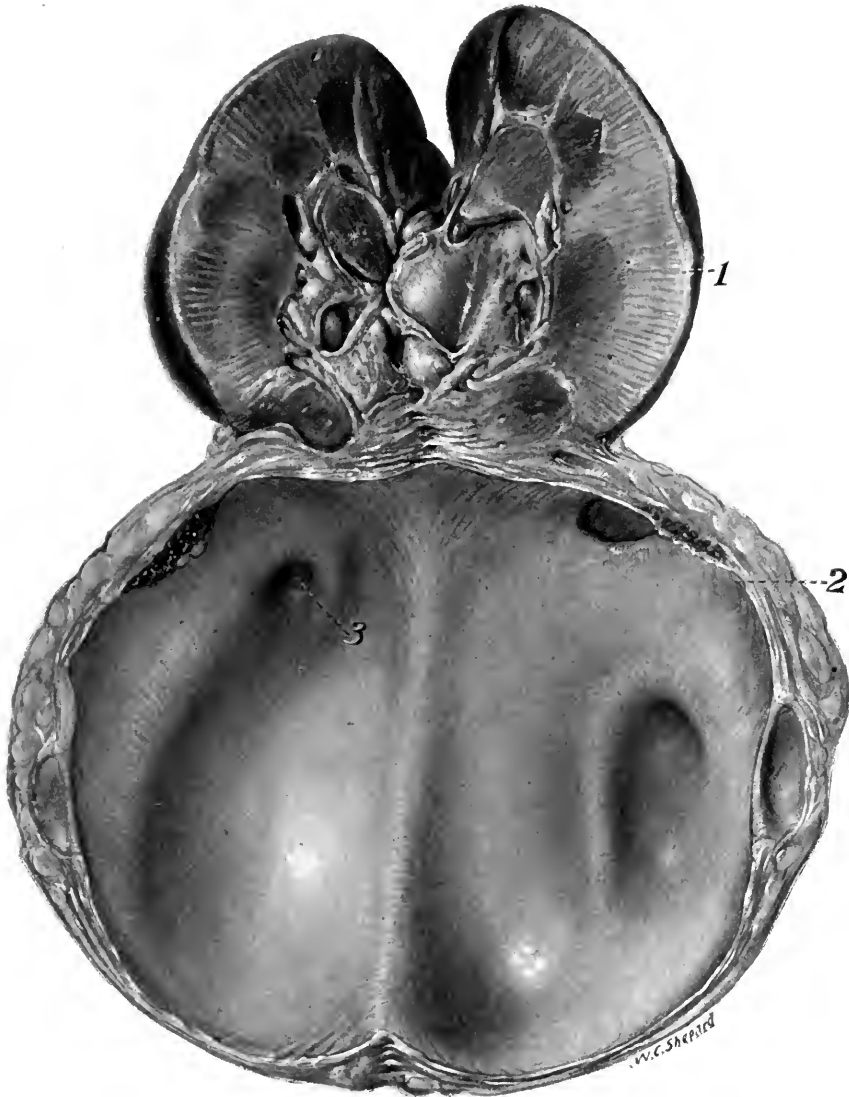


FIG. 6.—Sectional view of kidney shown in Fig. 5. Note normal upper (1) and hydronephrotic lower (2) half. No. 3 indicates location of ureteral orifice at upper portion of sac.

apply equally well to those of reduplication of the renal pelvis (double kidney). The frequency of the latter varies from 1.2 per cent. to 10 per cent. according to different authors; for example, Motzfeld<sup>5</sup> 1.2 per cent. of 972 autopsies, Papin<sup>6</sup> 2 per cent., Bostroem,<sup>7</sup> Pawloff<sup>8</sup> and Hrynteschak,<sup>9</sup> each 3 per cent., Poirier<sup>10</sup> and Shewkuneko<sup>11</sup> 4 per cent., Brewer<sup>12</sup> and Kroiss<sup>13</sup> 5 per cent., Robinson<sup>14</sup> 6 per cent., and finally Weigert<sup>15</sup> 10 per cent. It would seem, therefore, as though the average of 3 to 4 per cent. was a conservative one as to the frequency.

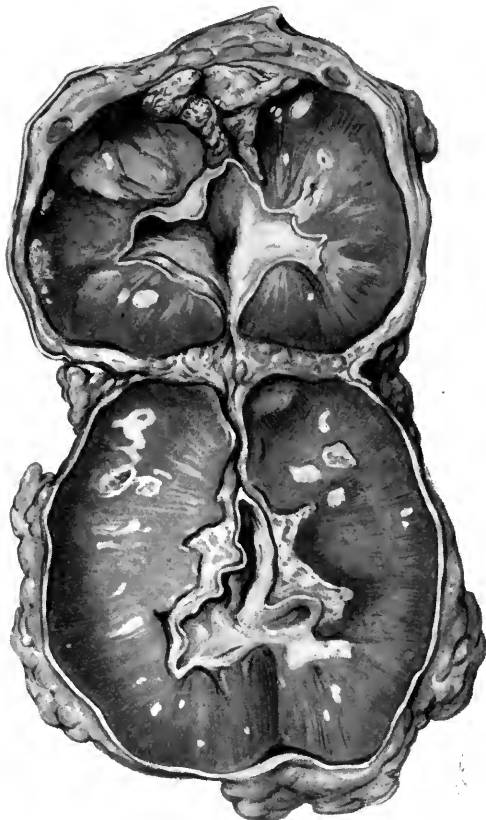


FIG. 7.—Tuberculosis of double kidney, showing complete separation of the two halves. (Marion.)

(b) Frequency of the condition on one or both sides: Braasch and Scholl,<sup>16</sup> in a series of 144 cases of reduplication of the ureters and pelves, observed at the Mayo Clinic from 1907 to 1922, found the condition in 135 (94 per cent.) on one side and in 9 (6 per cent.) on both sides. Of the former (unilateral) 36 (25 per cent.) were complete and 99 (68 per cent.) incomplete. Of the 9 bilateral cases 8 (5.5 per cent. of all reduplications) were complete and one (0.7 per cent.) incomplete.

Papin<sup>17</sup> reported 213 cases, that is, 165 (77 per cent.) unilateral and 48 (23 per cent.) bilateral cases. Of the former, 58 (35 per cent.) were incomplete and 107 (65 per cent.) complete. Of the bilateral 12 (25 per cent.) were incomplete and 36 (75 per cent.) complete.

Mertz<sup>18</sup> reported 276 cases, of which 202 (70 per cent.) were unilateral and 74 (30 per cent.) bilateral. Of the former (unilateral) 62 were incomplete (30 per cent.) and 140 complete (70 per cent.). Of the bilateral 10 (15 per cent.) were incomplete and 50 (84 per cent.) were complete. In 14 cases the anomaly was complete on one side and incomplete on the other.

From these observations of large series of cases one may say that in a total of 619 reduplications of the ureters and renal pelves, the condition was only found on one side in 80 per cent. and on both sides in 20 per cent.

Of 502 cases (80 per cent.) in which the condition was only found on one side, the reduplication was complete in 30 per cent. (156) and incomplete in 70 per cent. (346).

## DOUBLE KIDNEY

Of 117 (20 per cent.) cases in which the condition was bilateral, there was complete reduplication in 80 per cent. (94) and incomplete in 20 per cent. (23).

*Morphology* †.—From the clinical as well as the pathological standpoint we are interested in many features of reduplication of the renal pelvis and

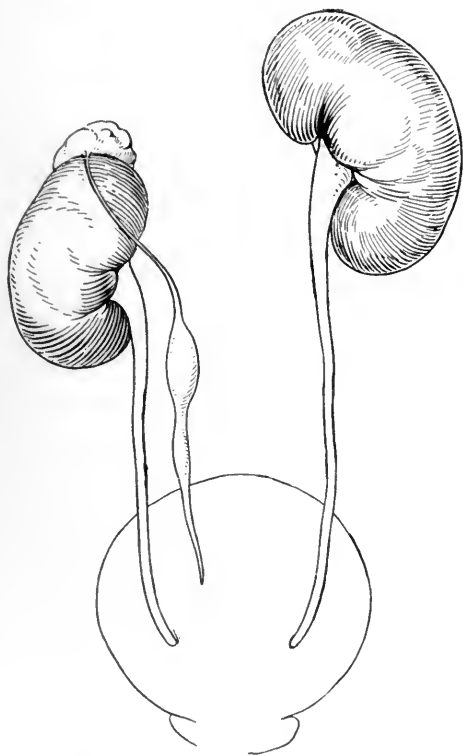


FIG. 8.—Unusual form of double kidney. At upper pole of right kidney is a second accessory kidney whose ureter crosses behind the lower half and ends blindly in wall of bladder. (See Fig. 9.) (Neckarsulmer.)

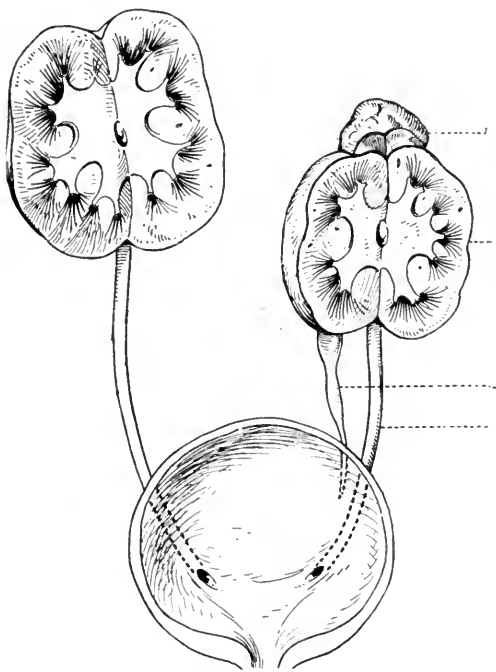


FIG. 9.—Same case shown in Fig. 8. Note how accessory hypoplastic upper half rests on lower half. (Neckarsulmer.)

ureter. For the sake of simplicity one may divide these into those relating to the kidney itself, and into those relating to the ureter.

*Kidney*.—*A*. Evidence of separation of the two halves. The following may occur:

(1) Continuity of the parenchyma, that is, absence of any sign of demarcation between the two halves either externally or internally (Figs. 1 and 2). A broad band of parenchyma separates the two pelves internally.

(2) A shallow groove marks the separation of the two halves externally (Fig. 3), and this is often accompanied by a more or less definite separation in the form of a fibrous septum (Fig. 4) internally or of a thin strip of parenchyma.

† The blood supply will be discussed in connection with technic.

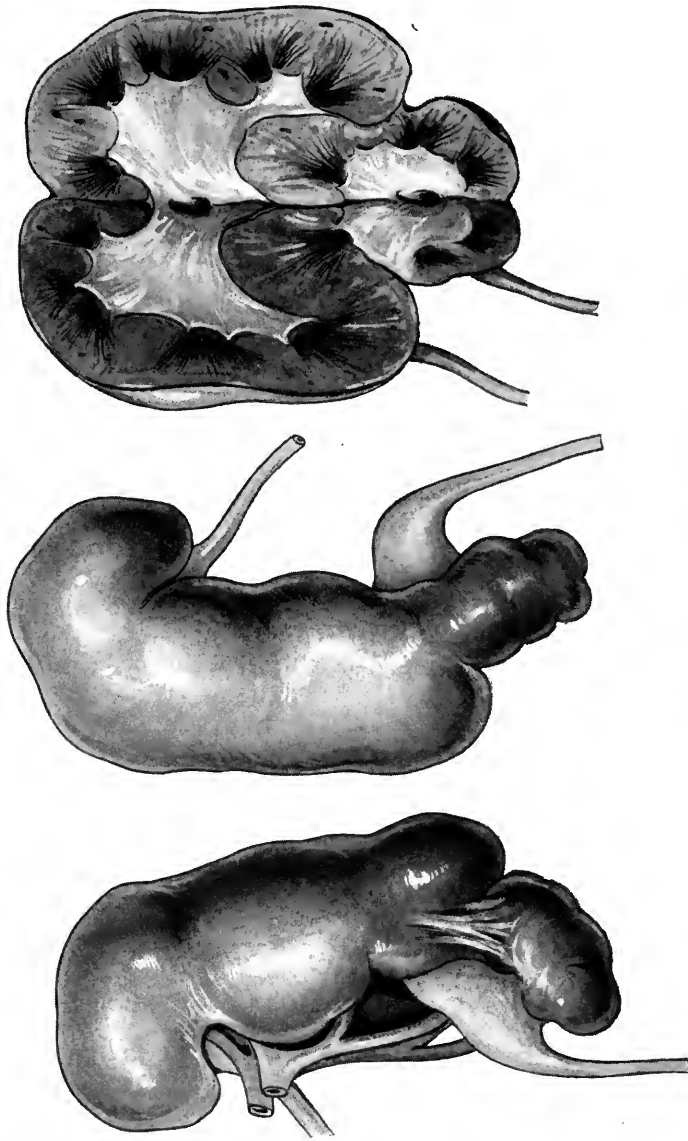


FIG. 10.—Three views of double kidney in which lower half was markedly hypoplastic. Note absence of separation of parenchyma. The ureters united just above bladder. (Wimmer.)



## DOUBLE KIDNEY

(3) A deep groove or furrow indicates the area where the two halves join (Fig. 5) and there is a corresponding well-marked separation internally (Fig. 6).

In some of the double kidneys belonging to (2) and (3) the pelves may lie so close together that it is impossible to separate them, especially when both are dilated, that is, hydronephrosis of both halves exists.

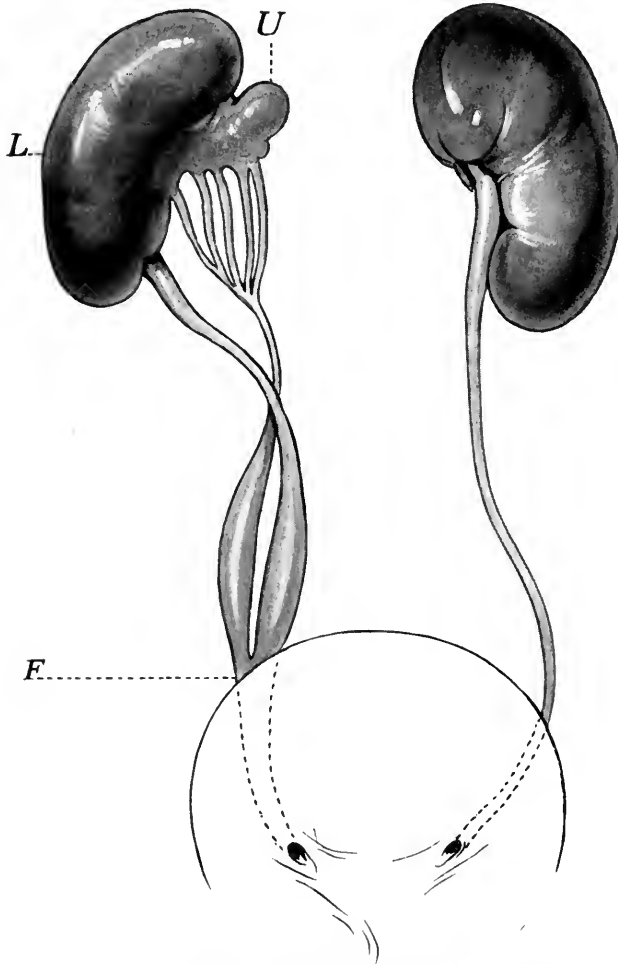


FIG. 11.—Hypoplastic (U) upper half of double kidney, with five primary calyces uniting externally to form ureter without any intermediary renal pelvis. (Fürstner.)

(4) A complete separation of the two halves is found both externally and internally. There is a distinct fibrous band between the two halves (Fig. 7). Such cases might be reported as instances of supernumerary kidney if the two halves are widely apart. The existence of a communication between the two pelves is denied by many but has been found by Braasch and Scholl.<sup>19</sup>

B. Relative size of the two halves.

As a rule the upper half forms about one-third, and the lower half the remaining two-thirds. The pelvis of the upper half is never as perfectly developed as that of the lower and is always smaller.

A number of cases have been described in which the upper or lower half was so small that they seemed to be mere appendages to the corresponding

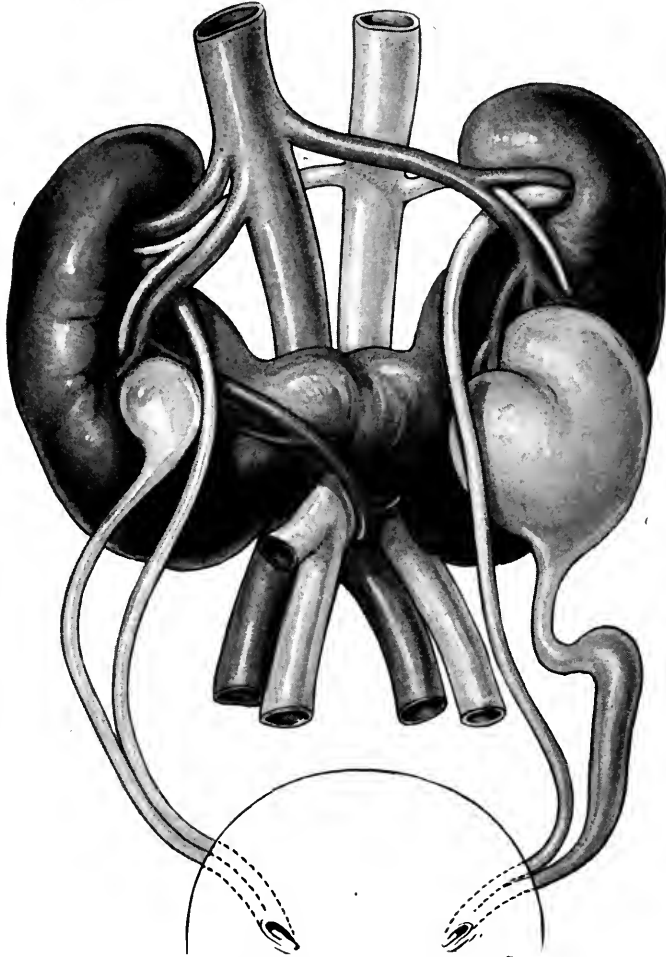


FIG. 12.—Autopsy specimen of horseshoe kidney with bilateral reduplication of the renal pelvises and ureters. Note hydronephrotic lower pelvises. (Zinner.)

other half. Some authors (Neckarsulmer) have suggested that such a hypoplastic half be called accessory kidney (*Beimiere*), but this distinction would only be confusing. The most typical example of such an extremely small upper half is the case reported by Neckarsulmer.<sup>20</sup> The ureter of this upper half crossed the posterior surface of the lower perfectly formed half (Fig. 8) and ended blindly in the wall of the bladder. On section one can

## DOUBLE KIDNEY

see (Fig. 9) the miniature kidney placed cap-like on the upper pole of the lower half. A similar case is reported by Wimmer<sup>21</sup> (Fig. 10) in which the lower half is attached in an appendix-like manner to the perfectly formed upper half.

A curious example of extreme hypoplasia of one-half is the case reported by Fürstner,<sup>22</sup> where the upper half is only partially attached to the lower

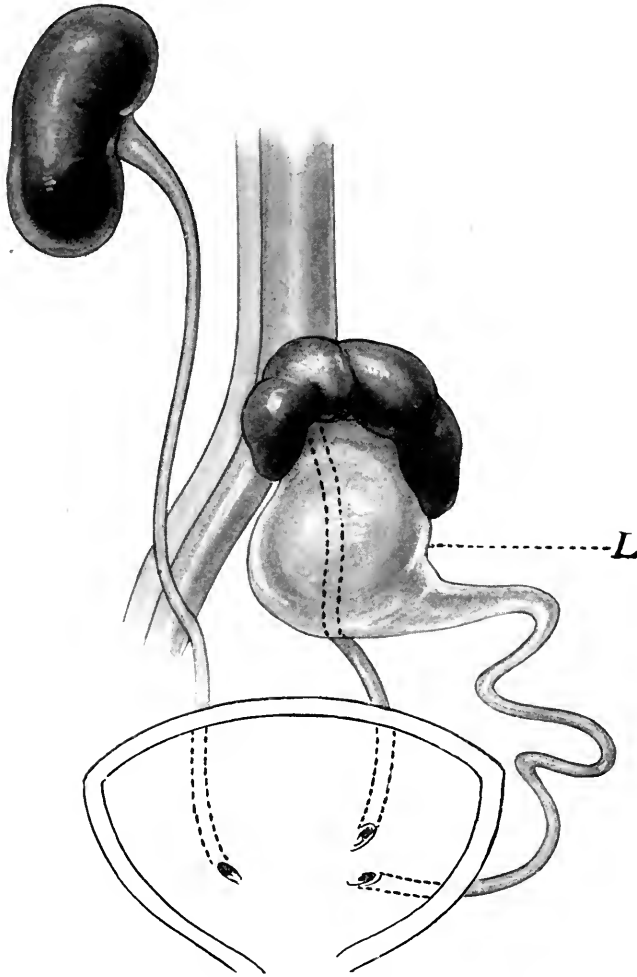


FIG. 13.—Ectopic (pelvic) double kidney. (Rumpel.)

half. As frequently occurs in all forms of anomalies of the kidney there is no true pelvis. The ureter arises directly as the result of the union of the primary calyces (Fig. 11).

C. Double kidney may be associated with other anomalies.

One frequently sees a combination of one form of renal anomaly with that of an entirely different group.

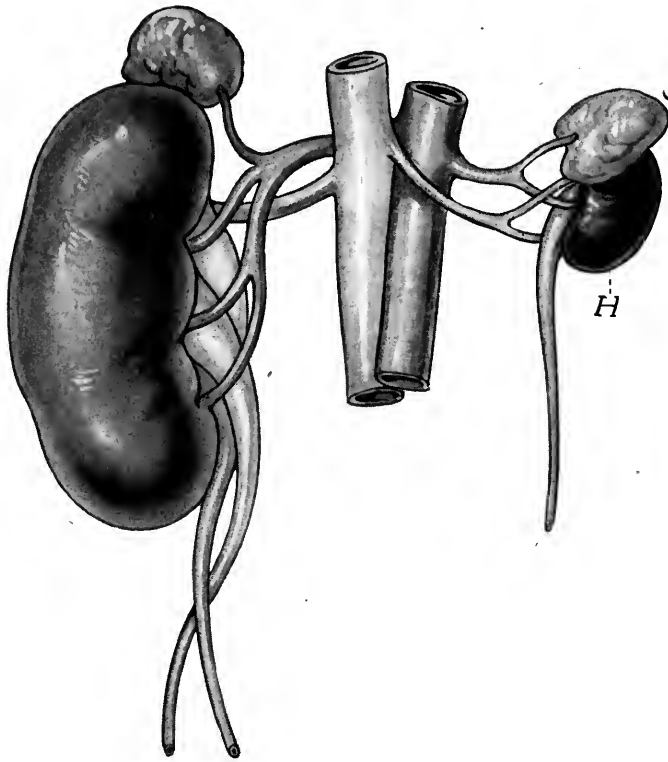


FIG. 14.—Right double and left hypoplastic kidneys. Left kidney size of adrenal with single ureter which ended normally. On right side large double kidney whose ureters ended one above the other at right angle of trigone. A single renal artery supplied both halves of the double kidney. (Gruber and Bing.)

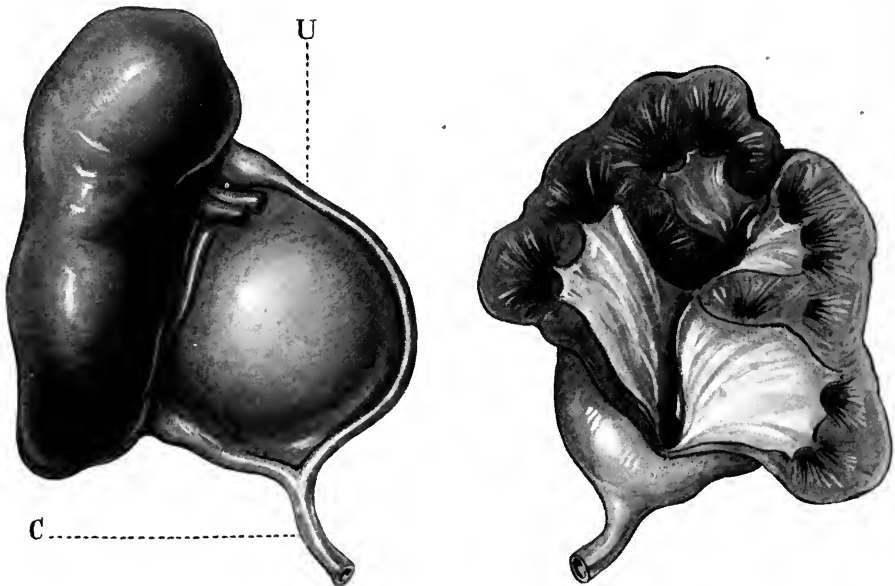


FIG. 15.—Specimen showing relation of the two ureters at renal hilum. Ureter from upper half (U) passes along mesial border of dilated pelvis of lower half to unite with ureter from lower half to form common ureter (C). (Wimmer.)

# DOUBLE KIDNEY

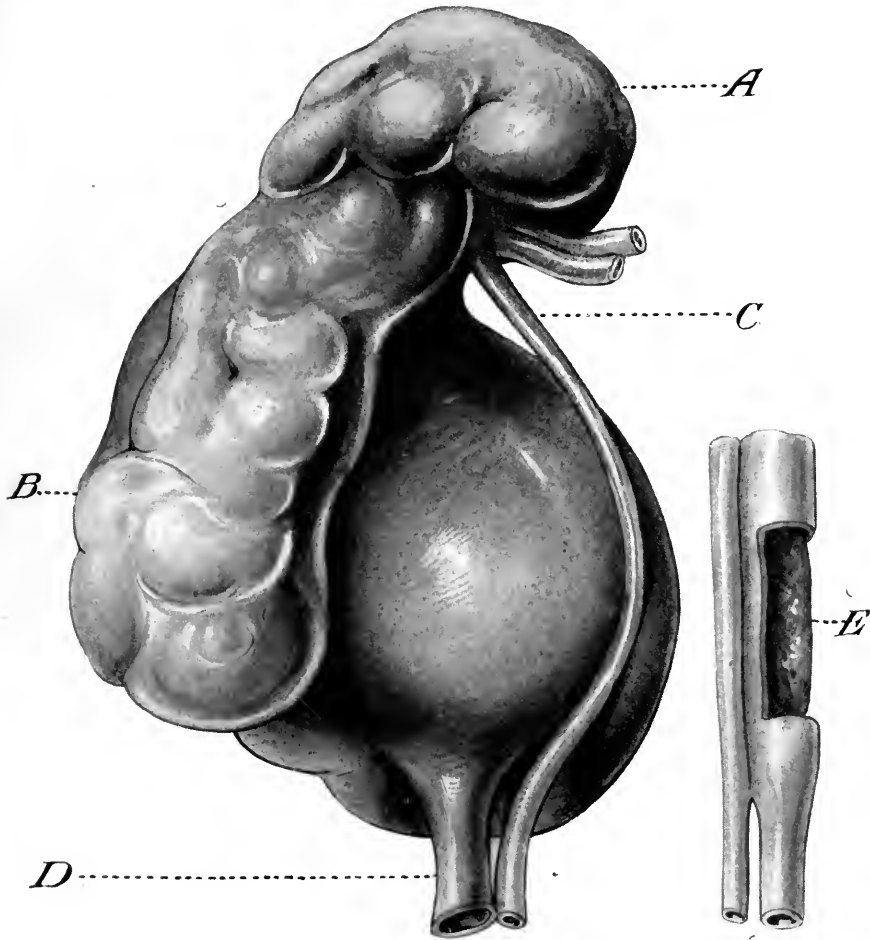


FIG. 16.—Pyonephrosis of lower half of double kidney due to calculus (E). Ureter of upper half (C) passed across pelvis of lower half. (Kusnetzky.) A. Upper half normal. B. Lower pyonephrotic half. C. Ureter of upper half. D. Ureter of lower half. E. Calculus blocking lower ureter. The two ureters united in bladder wall.

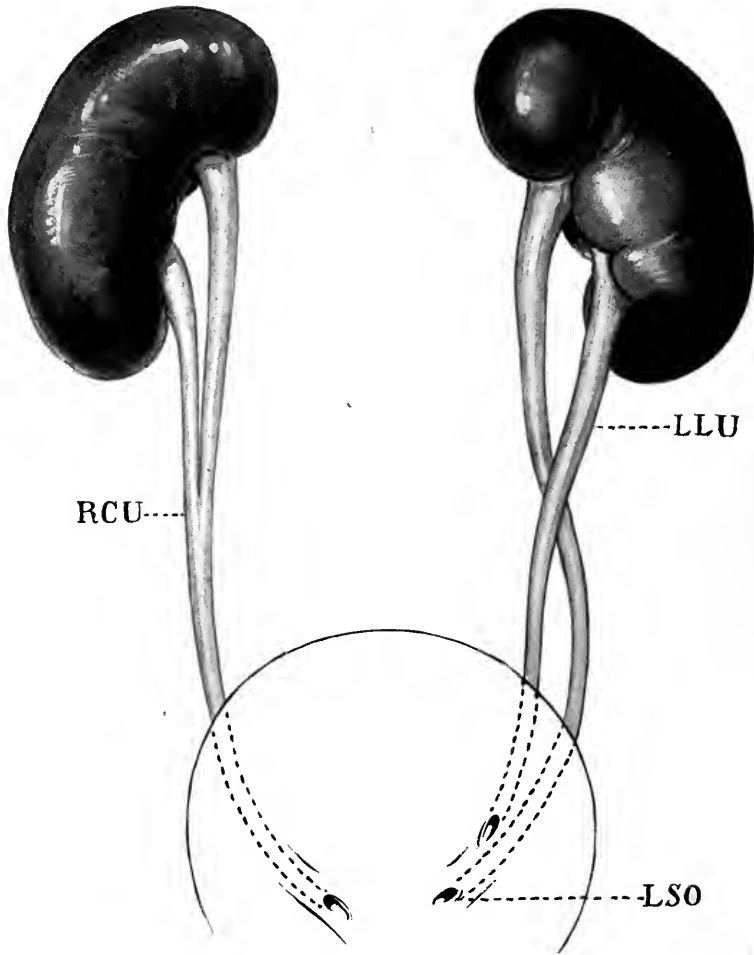


FIG. 17.—Bilateral double kidney. (Weigert.) On right side the two ureters unite at pelvic brim. On the left side the ureter from the lower half (LLU) ends at normal location, while that from upper half ends lower and more mesial (LSO).

Several instances have been reported in which each half of a horseshoe kidney had two ureters and two renal pelves. In Zinner's<sup>23</sup> case (Fig. 12) both lower pelves were dilated.

The double kidney usually lies a little lower than normal, but as in Rumpel's<sup>24</sup> case (Fig. 13), it may lie in the true pelvis and be mistaken for an ectopic kidney without reduplication of the ureters and pelves.

A most instructive case has been observed at autopsy by Gruber and Bing.<sup>25</sup> There was a typical double kidney (without external separation) on the right side and a hypoplastic kidney on the opposite side (Fig. 14).

*Ureter.*—*A.* Relation of the two ureters to each other at upper end and to the renal pelves.

This is of much importance from the surgical standpoint.

Each renal pelvis as a rule ends in a ureter, but as stated above there may be no true pelvis, only a number of calyces which unite to form the ureter (Fig. 11).

The distance between the two ureters at the hilus depends: (*a*) upon the relative size of each half, and (*b*) whether or not one pelvis or an entire half is enlarged as the result of a hydronephrosis, etc. Figure 5 from one of my own cases shows how the ureter of the upper half passed downward along the posterior surface of the lower hydronephrotic half and could be easily overlooked at operation.

The ureter of the upper half may lie throughout its course in the most intimate relation (Figs. 15 and 16) with the greatly dilated pelvis of the lower half and be difficult, if not impossible, to separate. Both ureters may lie in the same sheath along their entire course from the hilus downwards so that the presence of a reduplication may be overlooked unless such a diagnosis has been made before operation or a well-marked groove exists externally in the kidney proper.

Some cases have been reported as double kidney which are in reality examples of bifid renal pelvis, that is, where two large primary calyces unite either intra- or extra-renally to form the ureter.

*B.* Level of union, mode of crossing and of normal ending of ureters.

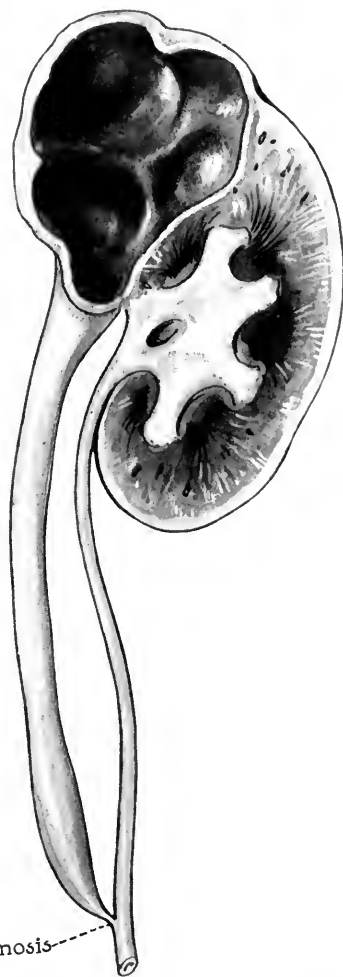


FIG. 18.—Pyonephrosis of upper half of double kidney. Stenosis of lower end of ureter from upper half. (Tschudy.)

The two ureters may unite at any level from a point just external to the hilus to one within the bladder wall. As a rule each ureter possesses its own sheath up to the point of union, but at times, as in a case recently reported by Schoonover,<sup>26</sup> the two ureters have a sheath in common so that separation is impossible. Even in cases of complete reduplication, the two ureters may



FIG. 19.—Most frequent location of ureteral orifices in double kidney. A. Both at same level. B. One above the other. Mesial and lower as a rule leads to upper half. (Batzner.)<sup>1,2</sup>

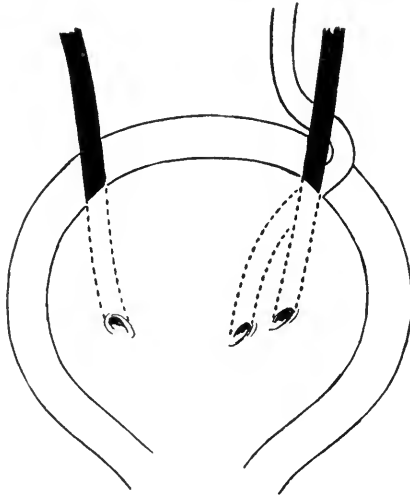


FIG. 20.—Case illustrating crossing of ureters close to or within bladder so that the ureter from upper half ends mesial and caudal to that from lower half. (Wimmer.)

be enclosed in a common sheath at their lower end, especially just above and within the bladder wall.

Of great interest from the clinical standpoint are the observations (*a*) that a stenosis of one ureter has been found where the two ureters unite (Fig. 18) and (*b*) that a communication may exist between the ureters as observed by Handl,<sup>27</sup> Klose,<sup>28</sup> Unterberg,<sup>29</sup> Seelig<sup>30</sup> and Wimmer<sup>31</sup> (Fig. 29).



DOUBLE KIDNEY

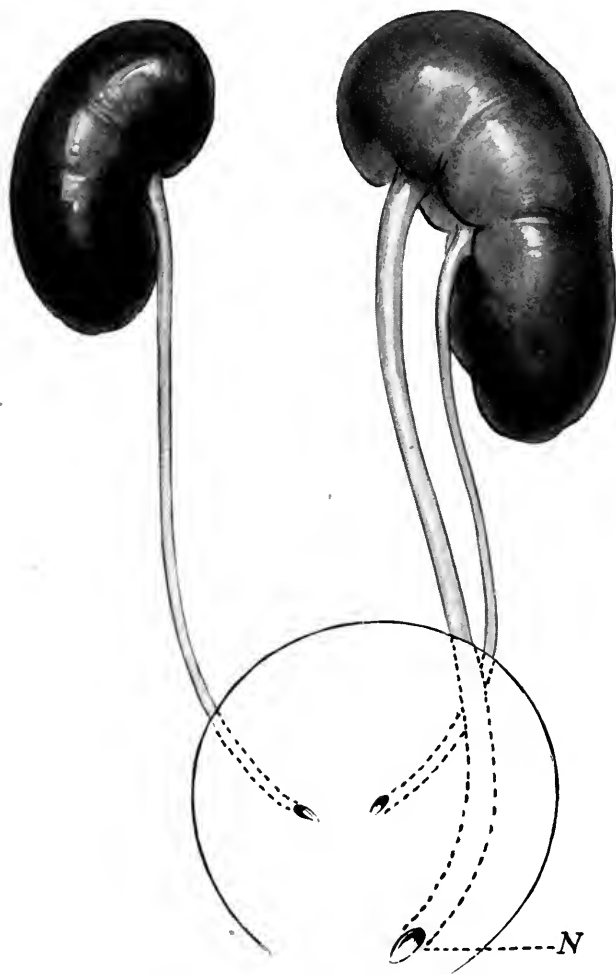


FIG. 21.—Double kidney (left) with ureter from upper half ending at neck of bladder (N). (Wrary.)

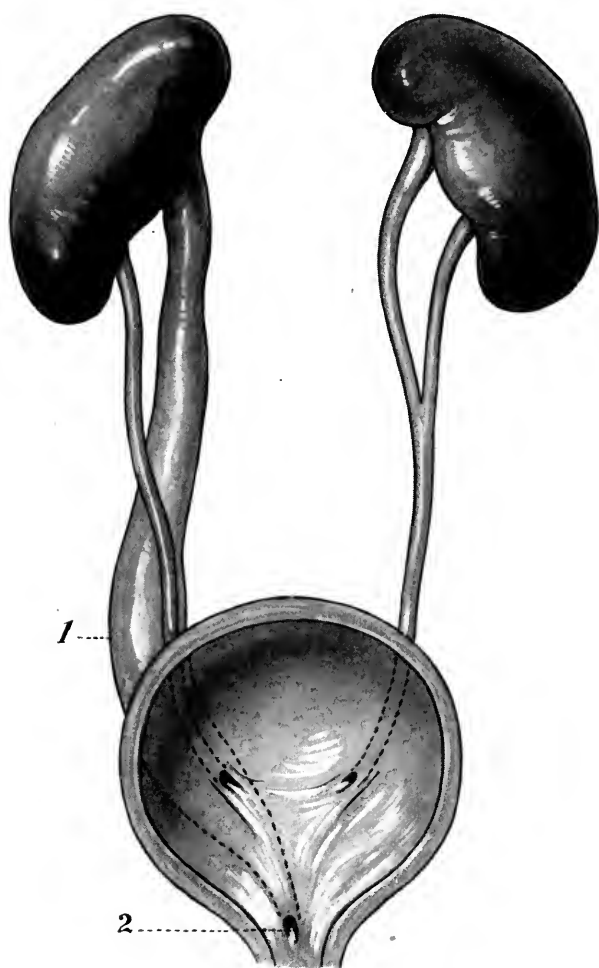


FIG. 22.—Ureter (1) of upper half of right double kidney ends in prostatic urethra (2). (Weigert.)

## DOUBLE KIDNEY

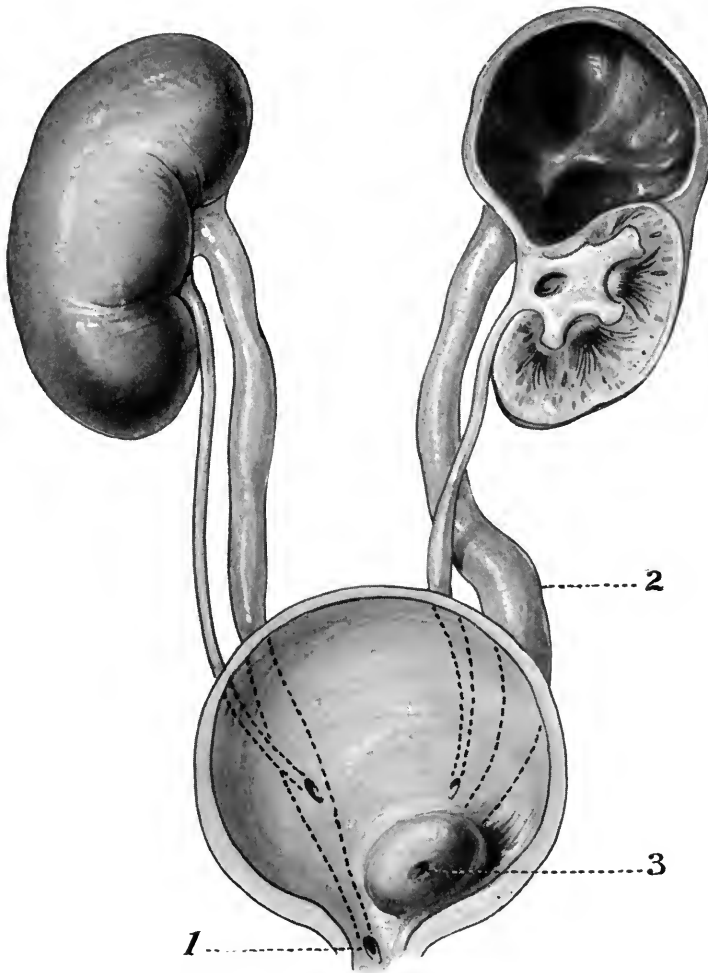


FIG. 23.—Bilateral double kidney. The dilated ureter from upper half of right kidney ends (1) at neck of bladder. On the left side the upper half was hydronephrotic. Its ureter (2) ended in a (3) cystic dilatation below the other ureter of same side. (Reinfelder.)

In Handl's case there was a slit-like communication where the two ureters crossed before entering the bladder wall. In Wimmer's case there was a broader communication in the intramural portion of the course of the two ureters.

The question of how the two ureters cross each other has been the subject of much discussion by a number of those interested in the subject.

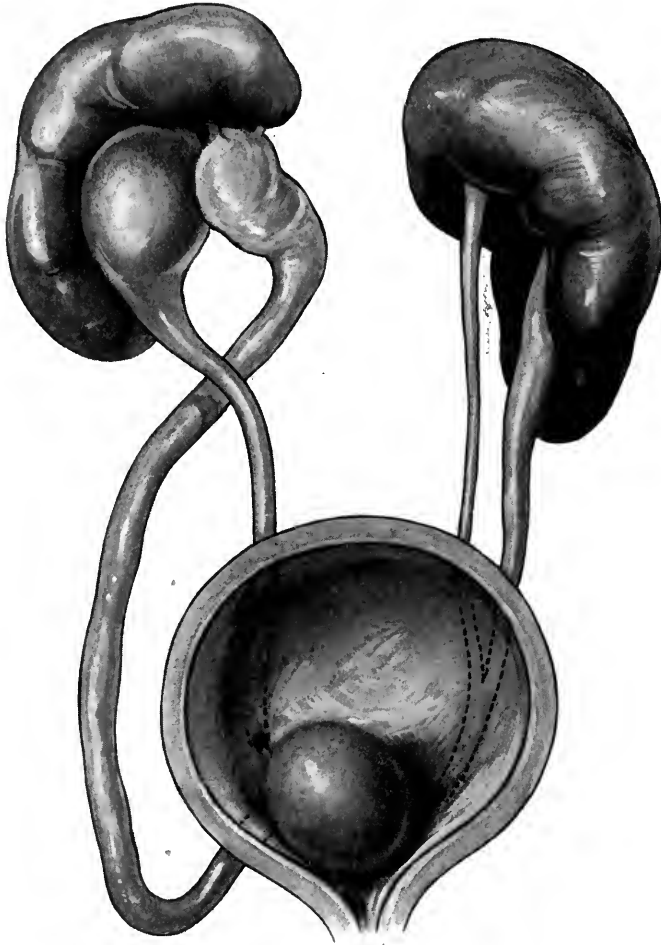


FIG. 24.—Bilateral double kidney. On left side ureters unite in wall of bladder. On right side ureters are both dilated. Ureter of upper half (right) ends in cystic dilatation which obstructed internal meatus. (Boström.)

The ureters never cross beyond the midline of the spine. Robert Meyer,<sup>32</sup> whose autopsy studies corroborated to a great extent those of Weigert,<sup>33</sup> states that the crossing of the ureters varies greatly and that they may not cross at all. When they do cross, it always occurs at two places in the same plane. Of the two adjacent ureters the mesial ureter always belongs to the upper half.

A rule to which there are few exceptions is that the final crossing (Fig. 20) of the ureters always takes place in such a manner that the ureter

belonging to the upper half crosses to the inner (mesial) side of the ureter belonging to the lower half, so that the former (ureter from upper half) ends mesial and more caudal (nearer bladder neck) than that from the lower half. There is no authentic case where the ureter from the upper half opened cranial to that from the other ureter.

In the bladder the two ureteral orifices as a rule either (*a*) lie one above the other (Fig. 19), the lower and more mesial being that of the ureter of the upper half, or (*b*) they lie closer together, the mesial and more caudal (Fig. 19) again belonging to the ureter of the upper half.

C: Ectopic or abnormal mode of ending of the ureters.

The only available statistics in regard to the frequency with which this occurs in double kidney are those of Mertz,<sup>34</sup> 42 (30 per cent.) of 140 complete reduplications, and of Braasch and Scholl,<sup>35</sup> 3 (12 per cent.) of 36 complete reduplications. The abnormal modes of endings of one or both ureters do not differ from those which may occur in the case of a single kidney on one or both sides of the body. The ureter from the upper half is usually the one which ends abnormally if only one ureter is involved.

The most frequent of the ectopic forms of ending are:

1. At neck of bladder (Figs. 21 and 23) in usual form of orifice.
2. In prostatic urethra (Fig. 22) in usual form of orifice.
3. One ureter ends in a cystic dilatation on the surface of which there may (Fig. 23) or may not (Fig. 24) be a small ureteral orifice. In one of Boström's<sup>36</sup> cases such a cystic dilatation blocked the internal meatus and resulted in an obstruction to both ureters of the double kidney (Fig. 24).
4. Both ureters end in cystic dilatation and communicate within the sac (Fig. 25).
5. One ureter may end blindly above or below or both (Fig. 26), the lower blind end dilating as in Clairmont's<sup>37</sup> case, containing calculi and forming a protrusion in the midline of the bladder.
6. One ureter ends in the seminal vesicle of the same side as that upon which the double kidney is located. A typical case of this type of opening into the male genital tract was reported by Hoffmann<sup>38</sup> (Fig. 27).

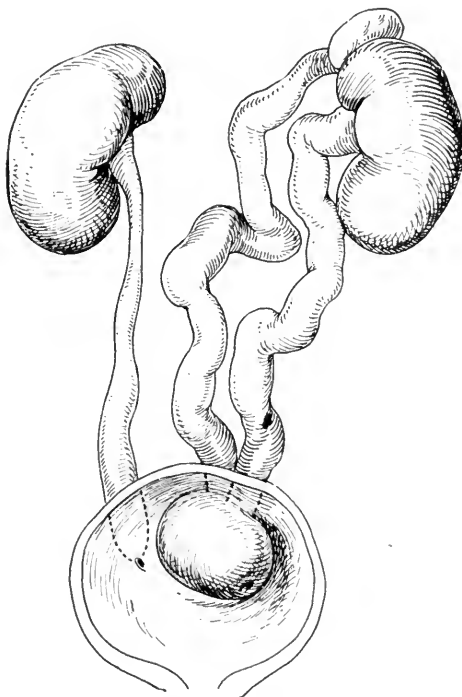


FIG. 25.—Both ureters end in a common cystic dilatation. Upper half of double kidney markedly hypoplastic. (Rendu.)

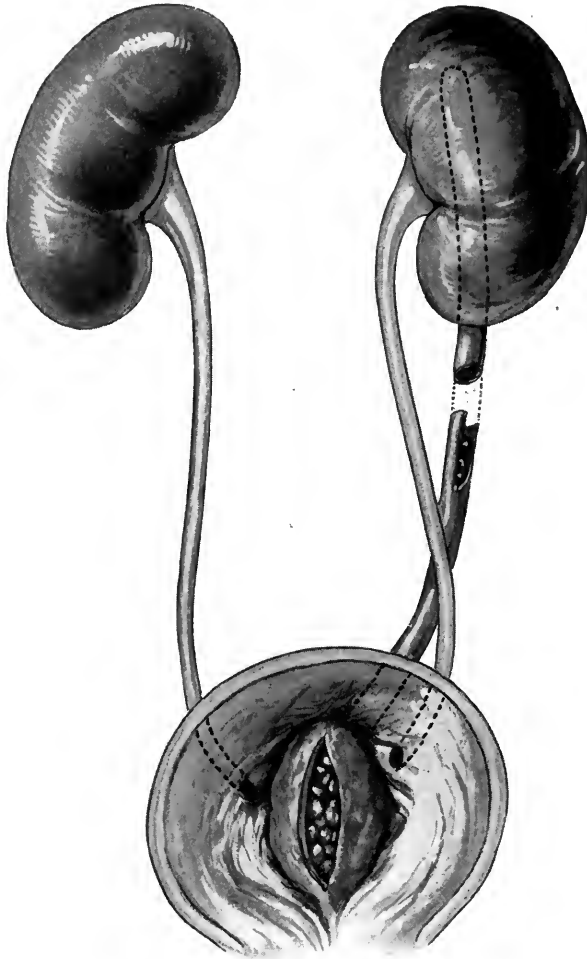


FIG. 26.—Double ureter (left). The second ureter ends blindly above and below. Its lower end greatly dilated and filled with calculi. A few calculi also found in middle portion of the accessory ureter. (Clairmont.)

## DOUBLE KIDNEY

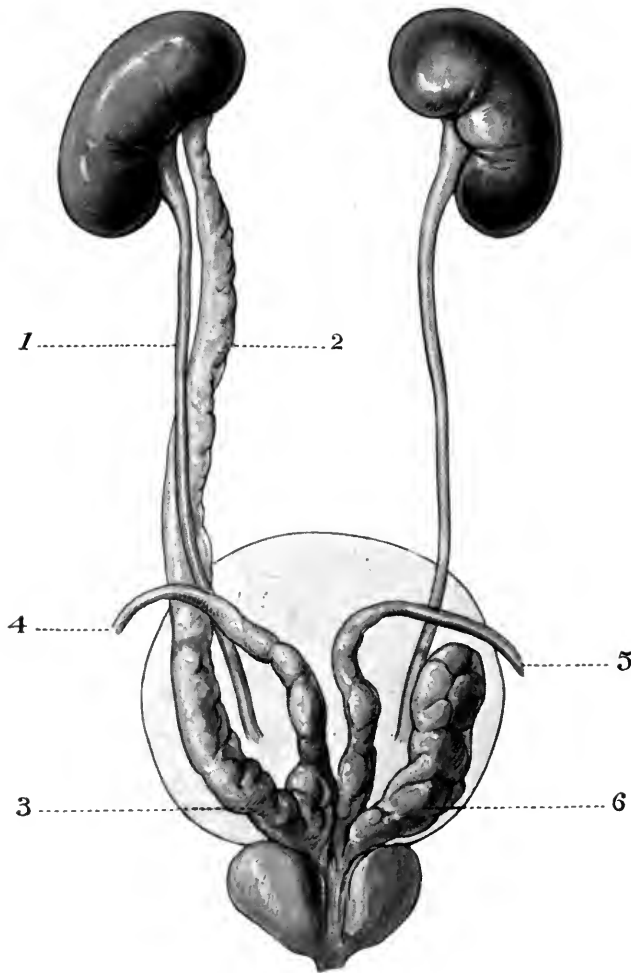


FIG. 27.—Ureter (1) of upper half of right double kidney ends in seminal vesicle of same side (3) Ureter (2) of lower half ends normally. (4) Dilated right vas deferens. (5) Left vas, and (6), seminal vesicle. (Hoffman.)

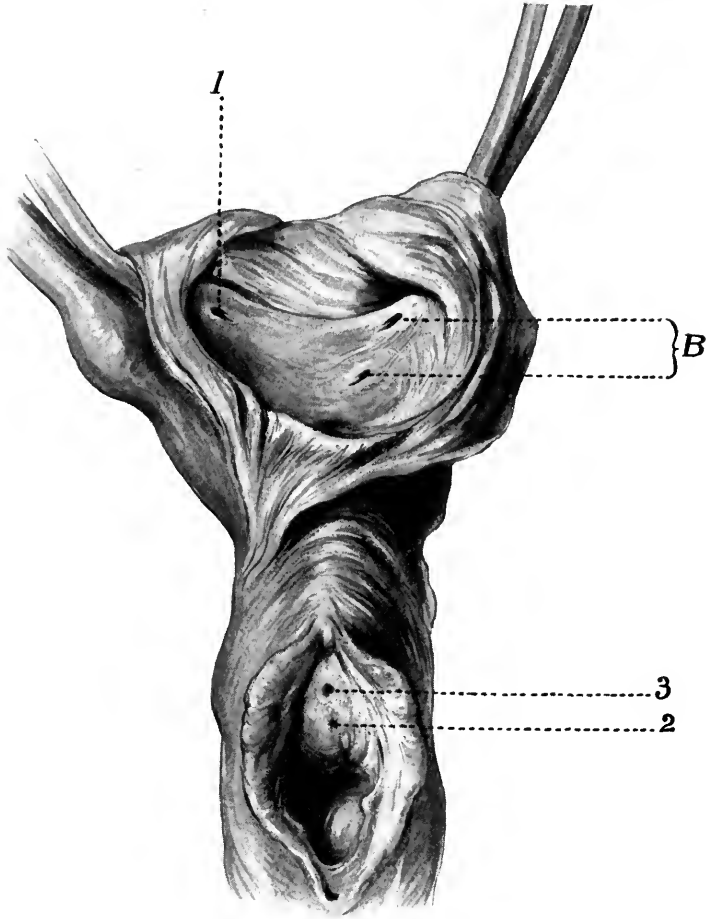


FIG. 28.—Bladder, lower portion of ureters and external genitalia from case of bilateral double kidney. On left side both ureters ended in bladder (B), while on the right side, one ureter ended (1) normally and the other (2) ended just below external (3) meatus. (Bætzner.)



7. Endings, either blind or by open ureteral orifice in the female genital tract: (a) urethra, (b) vagina, (c) vestibule—usually in the latter, below or lateral to the external meatus (Fig. 28). This will be referred to under the clinical aspects as one of the causes of incontinence of urine to be looked for in females.

Schwartz's<sup>39</sup> classification of abnormal ureteral endings is applicable to-day in spite of more advanced methods of diagnosis and is worthy of quoting at this point.

I. Open endings into male genito-urinary tract.

- (a) Into bladder (usually near neck) (Fig. 21).
- (b) Into urethra (Fig. 22).
- (c) Into seminal vesicle, ejaculatory duct and vas deferens (Fig. 27).

II. Open endings into female genito-urinary tract.

- (a) Into urethra.
- (b) Into vagina.
- (c) Into vestibulum vaginae (Fig. 28).
- (d) Into persisting duct of Gaertner.

III. Blind openings.

- (a) Into muscular layer of bladder.
- (b) Into submucous layer (Fig. 26) of posterior wall or floor of bladder.
- (c) Into a cystic dilatation (Figs. 23, 24 and 25).
- (d) Into submucous tissue of vagina or vestibule.

D. Associated defects of the male and female genitalia.

These are far more frequent in cases of solitary or hypoplastic kidney and in crossed ectopia than in either double or horseshoe kidney

(To be continued.)

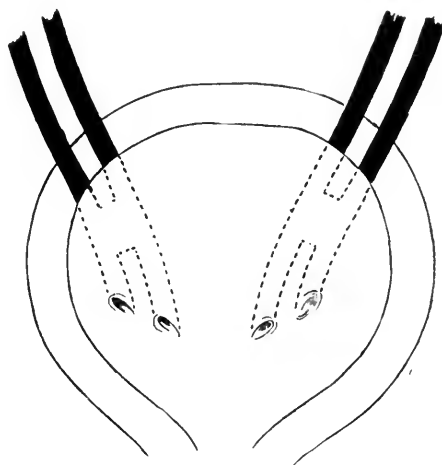


FIG. 29.—Bilateral double kidney. The two ureters of each side communicated in wall of bladder. (Wimmer.)

## SARCOMA OF THE UTERUS

By PHILIP J. REEL, M.D.

AND

PAUL H. CHARLTON, M.D.

OF COLUMBUS, OHIO

FROM THE DEPARTMENT OF PATHOLOGY, OHIO STATE UNIVERSITY

WHILE English observers at a very early period recognized that certain uterine tumors of a benign character recurred after operation, it remained for Virchow, in 1860, to first describe the gross and histologic pictures in a series of uterine sarcomata and particularly sarcomatous changes occurring in uterine myomata. Following this description these tumors have been discussed by many authors. In 1872, Chrobak directed attention to this type of neoplasm and in 1887, Ritter gave a review of the literature to that date.



FIG. 1.—Case No. 19705. Gross photograph of sarcoma of the uterus which presented marked para-uterine invasion, with the absence of fibromata. There was marked invasion of the broad ligament with no invasion of the uterine cavity, which is not seen in the photo.

Williams and Schreber, in 1895, gave a full discussion of the histology and histogenesis of these tumors. In 1889, Gessner published a most exhaustive study of sarcoma of the uterus. Since that time this tumor has been widely discussed principally by foreign writers. A review of this literature discloses the fact that while much, particularly of the later writings, have been upon the clinical aspects of this neoplasm, very little has been offered as an addition to our knowledge of its histology and histogenesis except in a recent study by Evans at the Mayo Clinic, in 1920. He concludes that the presence of large numbers of

mitotic figures is "the only single constant microscopic evidence of definite malignancy."

While this type of tumor is said to form less than 0.5 per cent. of all malignant growths of the uterus, our observations would lead us to believe that it occurs much more frequently than the literature, especially the American, would seem to indicate. We have been able to collect nine cases of sarcoma of the uterus from a series of two hundred and eighty-eight (288) uteri sent to the laboratory of the Department of Pathology of Ohio State University for routine examination. In addition there were two cases sent to the laboratory from other clinics, making the total of eleven (11) sarcomata in two hundred and ninety (290) cases studied. Of this number, one hundred and four (104) uteri were removed with the clinical diagnosis of uterine fibroids. Some of these cases are frank primary sarcoma of the

## SARCOMA OF THE UTERUS



FIG. 2.—Case No. 19705. High power photomicrograph showing connective tissue undergoing hyaline degeneration.

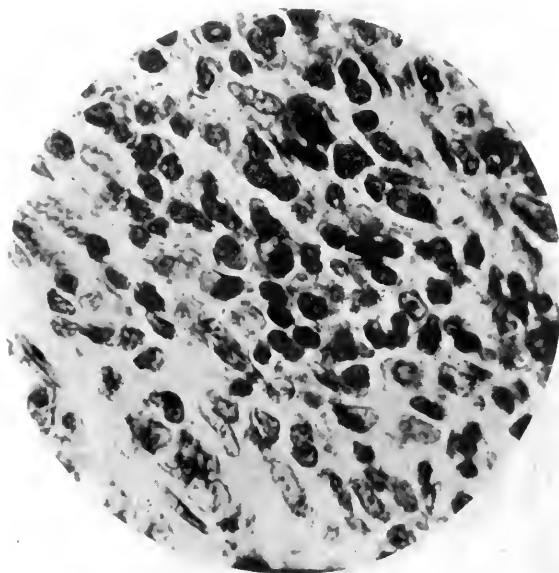


FIG. 3.—Case No. 19705. High power photomicrograph showing the gradual invasion of muscle by sarcomatous cells.

uterus, while others represent a sarcomatous change occurring, apparently, in preëxisting fibroids or as coexisting growths. With these facts in mind we believe a discussion of this type of neoplasm to be of extreme importance, and of sufficient gravity, to merit the study we have given it as well as to endeavor to interest the profession in this class of cases. It is evident that an accurate microscopic diagnosis is essential to establish, even to a limited degree, the further treatment necessary, as well as the prognosis.

While most authorities are in agreement as to the classification, clinical aspects, and treatment of this tumor, the question as to its histogenesis has

remained an open one. It is generally conceded by most authors that from 1.5 per cent. to 2.5 per cent. of fibroids show sarcomatous change. A resumé of the uteri examined in this laboratory would not tend to bear out the foregoing figures, in that we were able to find nine sarcomata in a total of one hundred and four (104) uteri removed because of a diagnosis of fibroids, making the percentage of occurrence in our series 8.6 per cent.

With this high percentage of occurrence it

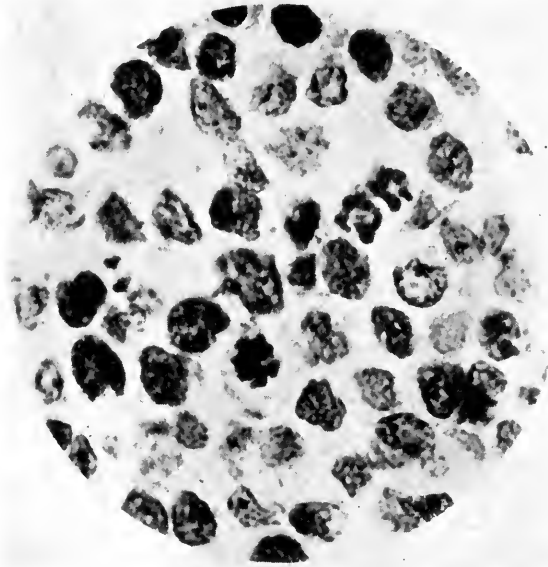


FIG. 4.—Case No. 19705. High power photomicrograph showing sarcomatous area and the presence of mitotic figures.

may be readily seen that it becomes necessary to make a careful gross examination of all fibroid masses found in these uteri and in addition a careful microscopical study of all areas in which suspicion is aroused, as evidenced by softening, change in color, decoloration, or fusion of the capsule and the surrounding tissue.

As a working classification, that suggested by Ewing would seem to be most satisfactory, namely, that sarcomata originate in the wall of the uterus or in the endometrium. The greater percentage of sarcomata undoubtedly arise in the wall, and this fact is borne out in our series of cases. Most authors, at the present time, agree that fibroid tumors may undergo sarcomatous change. It is difficult, at times, to decide whether the sarcoma has been such since its origin, or whether it has resulted from a malignant transformation arising within the preëxisting myoma. Several of our tumors presented nothing but sarcomatous cells. These have occurred as single tumor growths with a marked tendency to encroach upon the uterine cavity

## SARCOMA OF THE UTERUS

and seem to arise from the periglandular stroma. This type of tumor seldom, if ever, shows a tendency toward true encapsulation but rather tends toward a circumscribed mass, the edges of which fade rapidly into the uterine tissue without the formation of a distinct capsule. The portion of the growth which projects into the uterine cavity is covered by a mucous membrane which is usually atrophic and may show areas of necrosis, but still remains continuous with the remainder of the endometrium. This tendency toward necrosis may account for the more or less continuous type of hemorrhage encountered clinically in such cases.

A histologic examination of sections removed from many different areas of the tumors of our series would lead us to agree with Eden and Lockyear that in most cases the sarcoma cells arise from a metaplasia of the connective-tissue cells of the fibroid. In addition our series substantiates the observations of other writers, namely, that the spindle-cell type of tumor originates in the musculature of the uterus and the cells tend to differentiate as smooth muscle cells. It is possible that they may arise simultaneously from both sources, even in the same tumor. The fact that they may have a myogenic origin does not lead us to believe that the change has arisen from a malignant leiomyoma which we recognize as an exceedingly rare type of tumor, which in the majority of cases, can only be diagnosed by the presence of metastasis, elsewhere in the body. While it is evident that the histogenesis of these tumors may be only of academic interest, the histopathology plays an important part in that, not infrequently, they are diagnosed clinically and at times, even at operation, as benign uterine tumors, except when they present an advanced stage of malignancy, as evidenced by softening, infiltration and fixation of the masses.

Of the eleven cases forming the basis of this paper, nine presented grossly the picture of definite multiple fibroids. The gross section of these revealed in the majority of instances an area of apparent sarcomatous change enclosed within one of the fibroid masses. It was not uncommon to find a multinodular uterus with but one nodule showing sarcomatous transformation. This would tend to strengthen the contention that a sarcoma may arise in a preëxisting fibroid.

One of the remaining two was found to be a distinct globular mass, protruding into and occupying most of the cavity of the uterus. The consistency of this tumor was soft, friable, and upon gross section presented the typical yellowish color which seems to be characteristic of the endometrial



FIG. 5.—Case No. 20655. Gross photograph of endometrial type of sarcoma showing protrusion of the mass into uterine cavity, the margins of the mass being continuous with the uterine mucosa.

or mucosal type of sarcoma. The remaining specimen presented a diffuse growth involving the anterior and lateral walls of the uterus, with a marked invasion of the peri-uterine structures, and was of the above-mentioned yellowish hue.

The tendency toward interstitial extravasation and actual hemorrhage should draw particular attention to fibroid masses which contain areas of softening. This condition is seldom found in uncomplicated fibroids. The increased vascularity attendant upon malignant change apparently explains the presence of hemorrhage, which is rather prevalent in these sarcomatous

areas. While softening and necrosis may take place in the nonmalignant tumor, we seldom if ever encounter within the substance of the fibroid, blood-vessels of sufficient size to produce such hemorrhage unless it is directly associated with those vessels found within the capsule. While the presence of blood in some form should not serve as a criterion upon which to make a gross diagnosis of sarcoma, inasmuch as the same condition may be encountered in those tumors which contain an increased cellularity, it



FIG. 6.—Case No. 20655. Low power photomicrograph taken at the junction of the uterine mucosa with the mass, showing the atrophy of the glandular elements.

should arouse suspicion and demand microscopical examination.

Under the microscope, sarcoma of the uterus may present many different varieties of cellularity. In those uteri which present distinct fibroid masses, we may find in some instances a rather marked line of transformation from typical fibroid connective tissue into that of a very cellular sarcomatous structure. On the other hand, the sarcomatous change may gradually merge into the benign connective tissue and present throughout this region areas which if seen by themselves would be impossible of a diagnosis of anything other than an increased cellularity. Blocks removed from the somewhat more softened portion of the tumor wall show the typical sarcomatous arrangement, presenting very little if any adult connective tissue and the presence of well-developed round and spindle-shaped cells associated with a rather abundant blood supply. Areas of hemorrhage are also frequently found which may account for the gross softening often seen in these cases. The

## SARCOMA OF THE UTERUS

presence of mitotic figures is not infrequent, and when not found in these tumors which tend to remain myomatous, can be considered as a definite aid in making a differentiation from sarcoma. It is necessary, however, to carefully examine the section and not overlook the possibility of a soft fibroid showing mitosis, being a malignant leiomyoma. Careful study of the cell morphology as well as the history of the case, especially with reference to metastasis, should make this differentiation possible.

A microscopical study of the two cases which we have considered as coming under the classification of endometrial or mucosal origin would lead us to believe that the sarcomatous cells arise in the periglandular connective tissue, bearing in mind the fact, that the uterus, in the true sense, has no submucosa—the glands extending into the muscularis. This marked cellularity which is the predominant microscopical finding in this type of sarcoma would seem to explain the friability of the tumor and the early tendency toward hemorrhage which in some instances may be mistaken for the hyperplastic type of endometritis. This fact should

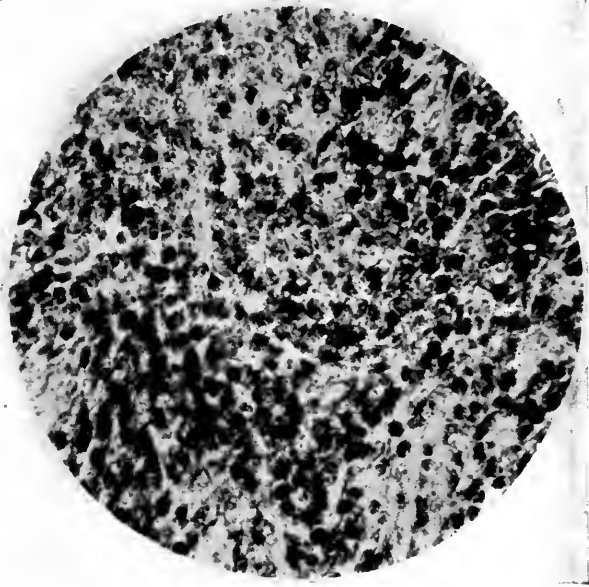


FIG. 7.—Case No. 20655. Low power photomicrograph showing marked cellularity of this tumor.

emphasize the importance of microscopical examination in those cases of hyperplastic endometritis subjected to curettage as a means of treatment. Microscopically, the type of cells composing this class of tumor are ovoid or round, very abundant, with little or no tendency toward adult cell differentiation, and usually show many mitotic figures.

### SUMMARY

We desire to emphasize the importance of a very careful microscopical study of all suspicious areas found in uteri removed where the clinical diagnosis is one of multiple fibroids. Even though the gross appearance of many uterine fibroids may be typical of the benign type of tumor, we have found upon routine sectioning areas which appear suspicious and that malignant change occurs in a much higher percentage of incidence (8.6 per cent. in our series) than we have heretofore been led to believe.

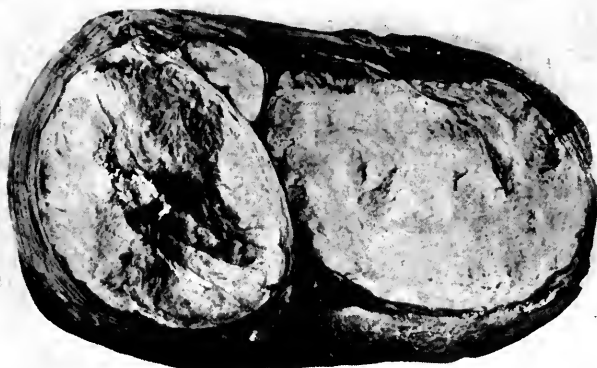


FIG. 8.—Case No. 21667. Gross photograph. Multiple fibroid of the uterus showing an area of sarcomatous change in one of the fibroid masses.

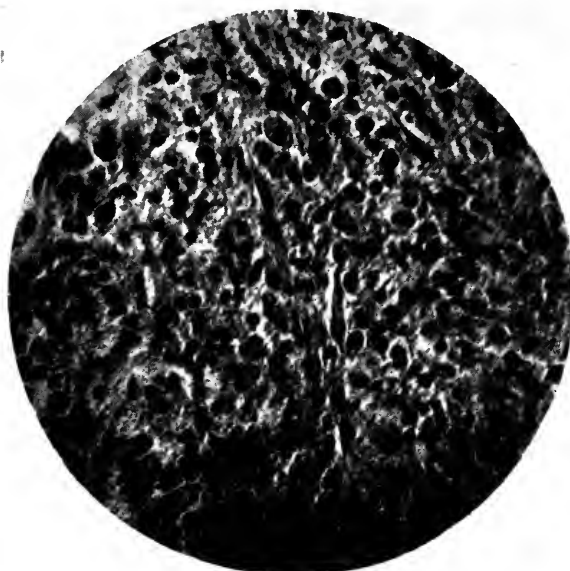


FIG. 9.—Case No. 21667. Low power photomicrograph of sarcomatous area, shown in figure 8.



It would seem that the connective tissue of a fibroid plays an important part in the histogenesis of sarcoma of the uterus. The endometrial type arising in the periglandular tissue of the stroma is the most malignant type of sarcoma of the uterus encountered.

# BIBLIOGRAPHY

- Aubert and E. Casse: *Marseille-Medical*, vol. lvi, pp. 1126-1128, Dec. 15, 1919.
- Andrews, H. R.: *Proceedings Royal Society Medicine*, Aug., 1921, vol. xiv, No. 10, p. 324.
- Beclere, A.: *J. de Radiol et d'Electrologia*, vol. iv, pp. 529-536, 1920.
- Begouin: *Revue de Gynecologie*, t. vol. xix, p. 279.
- Berard: *La Prov. Méd.*, 2 mai, 1896, no. 18 (Cite dans Piquand, Thèse de Paris, 1905).
- Bradly, Leo: *Johns Hopkins Hosp. Bull.*, vol. xix, pp. 164-165, 1918.
- Busse: *Deutsche medizinische Wochenschrift*, 1904, no. 10.
- Chrobak: *Arch. f. Gynak.*, vol. iv, 1872.
- Costes: *Recherches anatomo-pathologiques, sur l'évolution des fibro-myomes de l'uterus et de ses annexes*. Thèse de Paris, 1895.
- Devic et Gallavardin: *Contribution a l'étude du myome malin*. *Revue de Chirurgie*, t. vol. xxiv, 1901.
- Dudley: *Principles and Practice of Gynecology*, p. 422.
- Eden and Lockyear: *Gynecology for Students and Practitioners*, p. 510.
- Evans, Newton: *Surg., Gyn. Ob.*, vol. xxx, No. 3, p. 225.
- Ewing: *Neoplastic Diseases*, 2nd Ed., pp. 203-217, pp. 263-268.
- Forge et Massabuau: *Gynecologie*.
- Frankie: dans Liepmann, *Lehrbuch des Frauenheilkunde*.
- Gessner: *Feits Handbuch der Gynäkologie*, 1899, vol. iii, 2nd half, p. 957.
- Glanteny et Marie: *Bulletins de la Societe anatomique de Paris*, 1898, p. 291.
- Hedley, J. P.: *Proceedings Roy. Soc. Med.*, vol. x, pp. 81-82, May, 1917 (Sect. Obst. and Gyn.).
- Hellier, John B.: *Clinical Journal*, vol. xlv, pp. 417-422, Dec. 29, 1915.
- Jacquiu, P.: *Gynec. et Obst. Par.*, vol. iii, pp. 91-111, 1921.
- Jacobi, Mary P., and Wollstein, Martha: *Amer. Jour. Obst.*, 1902, vol. xlx, p. 218.
- Krische: *Inaugural Dissertation*, Gottinger, 1889.
- Langerhans: *Berliner klin. Wochenschrift*, 1893, no. 14, p. 338.
- MacCallum: *A Text-book of Pathology*, p. 968.
- Menetrier: *Le cancer (Traité de Médecine, Brouardel, Gilbert, Thoinet)*.
- Morris, Roger S., and Wooley, Paul G.: *Lancet-Clinic*, pp. 116-164-165, August 12, 1916.
- Meyer, R.: Dans Veit's *Handbuch der Gynakologie*, t. vol. i, p. 443. (Edition de 1908.)
- Minkowsky: *Munchener med. Wochenschrift*, 1901, no. 33.
- Paviot et Benard: *Archives des Médecine experimentale*, t. vol. ix, 1897.
- Pick, L.: *Archiv. v. Gynak.*, 1895, vol. xlviii, p. 24, und vol. xlv, p. 1.
- Piquand: *Revue de Gynecologie*, 1905.
- Piquand: Thèse de Paris, 1905.
- Ribbert: *Geschwulstlehre*.
- Ritter: *Inaugural Dissertation*, Berlin, 1887.
- Robin: Thèse de Bordeaux, 1912.
- Schlagenhaufen: *Weiner klin. Wochenschrift*, 1902, no. 20.
- Schottlander Kermauner: *Das Uteruscarcinoma*, p. 1, ix-x, no. 43.
- Schreher: *Inaugural Dissertation*, Jena, 1894.

## REEL AND CHARLTON

- Solomons, B.: Tr. Roy. Acad. Med. in Ireland, vol. xxxiii, pp. 328-329, 1915.  
Theodoroff: These de Montpellier, 1899.  
Thornton, John T.: West Va. Med. Jour., vol. iii, pp. 395-399, 1908-1909.  
Ulesco Stroganova: Monatsschrift, f. Geb. und Gyn., 1903, t. vol. xviii, p. 357  
Veit: Handbuch der Gynekologie (Ed. de 1907-1908).  
Vigues: Progrès de Médicale, 1921, vol. xxxvi, p. 289.  
Virchow: Die Krankhaften Geschwulste, vol. iii, p. 201.  
V. Franke: Festchrift für Rindfleisch. (Leipzig, 1907).  
Warner, Frank: American Journal Obst., 1917, vol. lxxv, p. 241.  
Whitridge Williams: Prager Zeitschrift t. Heilkunde, 1894, t. vol. xv.  
Wier, William H.: Amer. Jour. Obst., 1901, vol. xliii, p. 618.  
Williams, J. Whitridge: Amer. Jour. Obst., 1894, vol. xxiv, no. 6.

## SEPARATION OF THE UPPER EPIPHYSIS OF THE TIBIA

BY ALEXANDER GIBSON, M.B., F.R.C.S., ENG.

OF WINNIPEG, CANADA.

DIASTASIS, or epiphyseal separation, is an accident that is possible only in adolescent life or late childhood. It is rare before the age of twelve. According to Kirmisson, in a large majority of cases it is the result of indirect violence. The epiphyseal cartilage usually remains attached to the epiphysis, though this is probably not an invariable rule. The injury is frequently accompanied by extensive stripping of periosteum. It is stated that there is no epiphysis in the body which may not be detached as the result of injury. Much the most frequent sites of epiphyseal separation are the lower epiphysis of the radius and the upper epiphysis of the humerus. It is rather surprising that while detachment of the lower femoral epiphysis is comparatively common, and partial detachment of the tongue-shaped process of the upper tibial epiphysis is also common (Osgood-Schlatter disease), separation of the upper epiphysis of the tibia itself is extremely rare, while detachment of the upper fibular epiphysis alone is unrecorded.

According to Roberts and Kelly (1916), only 26 cases of diastasis of the upper end of the tibia have been recorded. Cases were reported by Heuston and Manly in 1888. In 1895 the subject was discussed by Jonathan Hutchinson, Jr. He stated that he had notes of ten cases. Poland referred to 24 cases. Tanton, in 1916, recorded a case which occurred in a boy of twelve, who was knocked down by an automobile, a wheel of which passed over the upper part of the left leg. The fibula was not broken, but the upper epiphysis of the tibia, perched on the arête formed by the anterior border of the upper end of the diaphysis, was split into two unequal pieces.

Reduction was brought about by traction under anæsthesia followed by fixation in plaster-of-Paris in the position of flexion.

The patient was seen six months afterwards and the result was "perfect."

*Age.*—Hutchinson's youngest patient was twelve months. His oldest sixteen years. Poland's cases ranged from three to twenty years.

*Cause.*—The usual history is of a violent wrench to the leg accompanied by abduction or adduction producing a transverse strain. In Poland's opinion, direct pressure against the epiphysis is the chief factor. In a case recorded by Fischer and Hirschfeld "a severe machinery accident caused separation of the upper tibial epiphysis and detachment of both fibular epiphyses." Hutchinson refers to specimens in St. George's and the London Hospital museums. In one of these the foot was run over and the leg bent forcibly inwards.

The upper epiphysis of the tibia owes its comparative immunity from detachment partly to its small size, as compared with the lower femoral epiphysis, but mainly to the fact that it is surrounded by very strong ligamentous and periosteal guards. The tibial collateral ligament of the knee-joint, the ligamentum patellæ, and the semi-membranosus not only gain attachment to the epiphysis itself, but all three structures send off strong prolongations to the neighboring periosteum and deep fascia. On the medial side, the line of junction of epiphysis and shaft is strengthened by the tendons of sartorius, gracilis, and semi-tendinosus. On the lateral side the head of the fibula forms a direct buttress to the epiphysis and the fibular collateral ligament forms a flying buttress. Also worthy of note is that from the first movement of leg on thigh, the upper tibial epiphysis is accustomed to strains with a transverse component whereas the lower femoral epiphysis is habituated mainly to direct thrusts.



FIG. 1.—Condition on admission.

In view of the severity of the violence producing the lesion, it is rather strange that the diastasis is seldom compound.

*Clinical Features.*—The displacement is usually incomplete and frequently very slight. In direction it is usually forwards, forwards and outwards, or forwards and inwards. In several cases extensive fracture of the diaphysis is recorded. In all but one of Poland's cases, the separated epiphysis carried with it the tongue-shaped process forming the upper part of the tibial tubercle. There is usually considerable swelling of the tissues in the neighborhood owing to effused blood. The knee-joint itself is generally full of fluid. At first sight the injury suggests a posterior dislocation of the knee-joint. This is ruled out by the age of the patient, by exact interpretation

of bony points, and finally by the X-ray.

*Prognosis.*—This is on the whole rather less reassuring than one would suppose. In 12 of the cases mentioned by Poland the patient died or the limb was amputated. Probably in many cases the original violence is so great that the patient suffers severely from shock or from accompanying more serious injuries. Septic infection, however, seems to play an important rôle in the progress of the case. One of Hutchinson's cases developed suppuration on the sixth day after the accident, with "emphysema and pus, followed by death," probably an anaërobic infection. The case narrated by Fischer and Hirschfeld developed suppuration six weeks after the injury. Amputation was performed. The tearing of soft parts, the outpouring of blood, and the devitalization of the skin, form ideal ground for bacterial development. The

## SEPARATION OF EPIPHYSIS OF TIBIA

pressure of splints, however light, may be enough to tip the balance in the direction of necrosis, especially if the adjustment of parts be not absolutely accurate. While this unfortunate denouement is not infrequent, it is not the rule. According to Poland, "in several of the cases which recovered, no trace remained of the injury."

Does shortening of the limb ever occur? According to Kirmisson, "notwithstanding the contrary results of experimental research, shortening of the injured limb has been rarely noted in actual practice . . . It is necessary to take into consideration compensatory elongation of the neighboring epiphyses." The older the patient, the more nearly full growth has been attained,

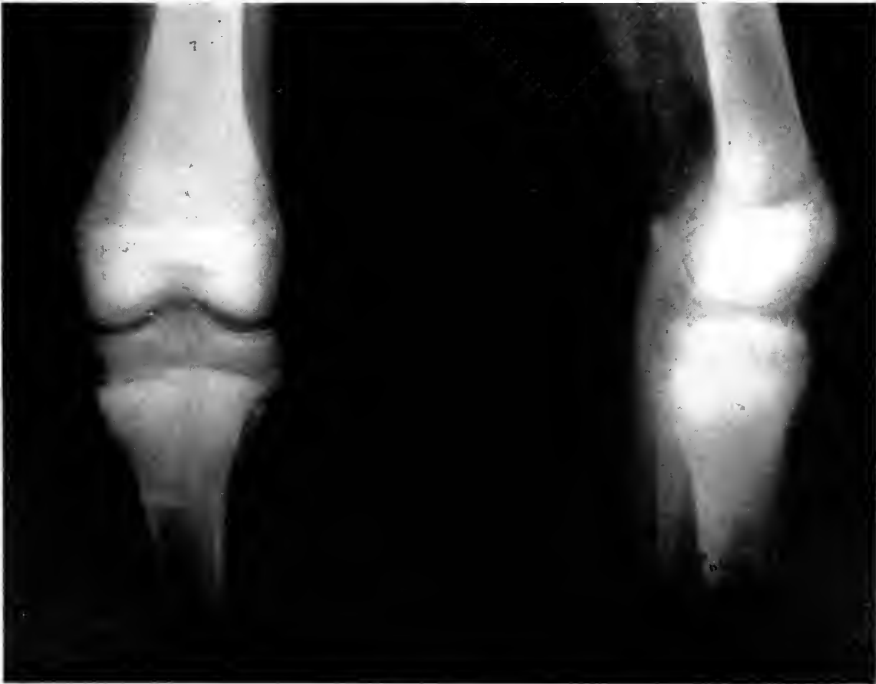


FIG. 2.—Condition on discharge.

the less the influence of stoppage of growth at an epiphysis. Further, the upper tibial epiphysis is only one, and not the most important, of the growing nodes of the lower limb. Again, a separated epiphysis may mean cessation of growth but does not necessarily do so. On the whole, therefore, provided reposition be exact, the prognosis regarding growth is good.

One example of premature arrest of growth is recorded by Volkmann. "A boy aged three had been knocked about by a drunken father. At the age of four he began to limp. After this no more growth occurred at the upper end of the tibia. The shortening which resulted was 3 inches. The femur of that side, the foot, and indeed the whole lower limb partook to a less extent in the lack of development." (Quoted from Hutchinson.)

The following case came under the notice of the writer lately. Because of the rarity of the condition it seems worth recording. P. M., male, aged fourteen years, was referred by Dr. W. Tucker, Francis, Sask. July 10, 1922, the boy got his left lower limb caught in the wheel of a plough. The skin was not broken.

July 19, 1922, examination showed marked swelling and discoloration about the left knee. The appearance suggested a backward dislocation of the tibia on the femur. Swelling was so great that it was impossible to distinguish accurately the bony prominences around the knee. There was marked laxity in all directions, and pronounced ecchymosis in the popliteal space. There was no swelling of the leg; no interference with circulation in the toes, no evidence of a nerve lesion. X-rays showed a diastasis of the upper epiphysis of the tibia with a fracture of the upper end of the fibula, a short distance below its epiphysis. The tibial epiphysis was displaced forwards and slightly laterally in relation to the shaft. The tongue-shaped process corresponding to the tibial tubercle remained attached to the epiphysis, thus obscuring the abruptness of the backward displacement. The upper tibial epiphysis maintained its normal relation to the lower end of the femur.

July 20 a curved incision was made on the medial side of the knee, and tissues were dissected through until the bone was reached. A large quantity of blood clot was removed from the wound. There appeared to be a good deal of pulping of the muscles posteriorly. It was found to be comparatively easy to replace the bone in its normal position, but exceedingly difficult to maintain it there. The epiphysis itself was tilted forwards and the best apposition was obtained with the knee flexed about  $30^{\circ}$ . A cuff of plaster was applied over the dressings to include the calf and the lower half of the thigh. Traction ropes were incorporated in the plaster, at the level of the upper part of the calf. By means of the traction ropes the limb was slung from a cradle, the axis of the pull being almost in the line of the thigh.

August 5, plaster was removed, stitches were taken out, the leg cautiously straightened and an X-ray taken. The X-ray showed good position antero-posteriorly, but there was still a trace of lateral displacement, producing in the fully extended position a slight degree of genu valgum. Fresh plaster was applied with the knee fully extended. This reached from the toes to the groin, and a clinical correction of the genu valgum was made. This plaster was worn until September 19, a window being cut for the dressing of a skin slough, about one inch in width and three inches long, adjoining the line of the incision.

After removal of the second plaster another radiograph was taken. Clinically and radiographically, the result promises to be entirely satisfactory. (Fig. 2.)

*Comment.*—The necessity for partial flexion of the knee was very strikingly manifested while the wound was open. It was possible to gauge with accuracy the degree of flexion necessary to maintain apposition and the direction in which traction could be best applied to maintain the optimum position. It is a truism that the best anatomical reposition is likely to give the best functional result. While treatment on a McIntyre splint might have given an equally good result, it could hardly have been carried out with the same degree of confidence in the result. The removal of the blood clot was also a distinct advantage. In the case of the fractured fibula, union appears to be satisfactory.

## SEPARATION OF EPIPHYSIS OF TIBIA

### REFERENCES

- Fischer and Hirschfeld: Berlin klin. Wchnsch., 1865, p. 93.  
Hutchinson: Brit. Med. Jour., 31st, March, 1894.  
Keen: Surgery, vol. ii, p. 260.  
Kirmisson: Rev. d'orthop, 2s. vol. v, pp. 523-552.  
Poland: Traumatic Separation of the Epiphyses.  
Roberts and Kelly: Fractures, 1916.  
Stimson: Fractures.  
Tanton: Bull. et Mém. Soc. de Chir. de Paris, 1916, vol. xlii, pp. 27-30

## SPONDYLOLISTHESIS

BY S. KLEINBERG, M.D.

OF NEW YORK, N. Y.

IN reporting another case of forward subluxation of the last lumbar vertebra, I desire to emphasize three points: (1) The condition occurs more frequently in males than we have heretofore believed; (2) the lesion presents a radiographic appearance which is pathognomonic and has not been found or described in any other lesion, and (3) trauma is frequently the direct cause, or at least, a very important factor in its etiology.

*Anatomy of the Lumbo-sacral Region.*—The lumbar vertebræ are placed one below the other, with the fifth lumbar situated in a wide interval between the fourth lumbar and the sacrum. The bodies of the lumbar vertebræ are large, the transverse diameter longer than the vertical, and in a flat photographic impression they appear quadrilateral. The sacrum is tilted forward on a transverse axis so that its superior surface faces upward and forward. The fifth lumbar, lying upon the sacrum, is also tilted forward, though to a less degree, so that its superior surface is directed upward and forward. The forward inclination of the fifth lumbar has been assumed to be a weak point in its relationship with the sacrum. In a lateral view one gets the impression that the fifth lumbar is ready to slip forward off the sacrum, and that it is restrained only by the ligamentous attachments. The lumbar articular processes, placed in the sagittal plane, favor a dislocation.

*The X-ray Appearance of the Normal Lumbo-sacral Region.*—The radiographic appearance of the lumbo-sacral region varies according to the location of the X-ray tube in relation to the last lumbar vertebra. If the tube is directly over the lumbar vertebræ so that its central rays pass through the lumbo-sacral junction, the lumbar vertebræ appear, in an antero-posterior view, as quadrilateral shadows. (Fig. 1.) The last lumbar is distinctly visible and is larger than, or at least as large as, the other vertebræ. The intervertebral spaces above and below the last lumbar measure at least a quarter of an inch in the vertical direction. Laterally the intervertebral spaces are bridged across by the articular processes. The main feature which I wish to direct attention to in this picture is that each lumbar vertebra is distinctly outlined and the fifth lumbar is separated from the sacrum by an appreciable interval. At about the middle of each vertebra is a small shadow differentiated from the surrounding bone by its greater density; this is the spinous process. The sacrum is approximately triangular, with its base directed upward; there are curved transverse lines in its shadow representing the transverse ridges between the various sacral segments.

If a lateral view is taken with the tube over the lumbo-sacral region, the bodies of the lumbar vertebræ appear as a series of square blocks, their



## SPONDYLOLISTHESIS

anterior and posterior surfaces forming somewhat curved but continuous lines. The anterior part of the intervertebral space between the last lumbar and sacrum is wider than the posterior part, but the lines of the anterior and the posterior surfaces of the lumbar vertebræ are continued to the corre-

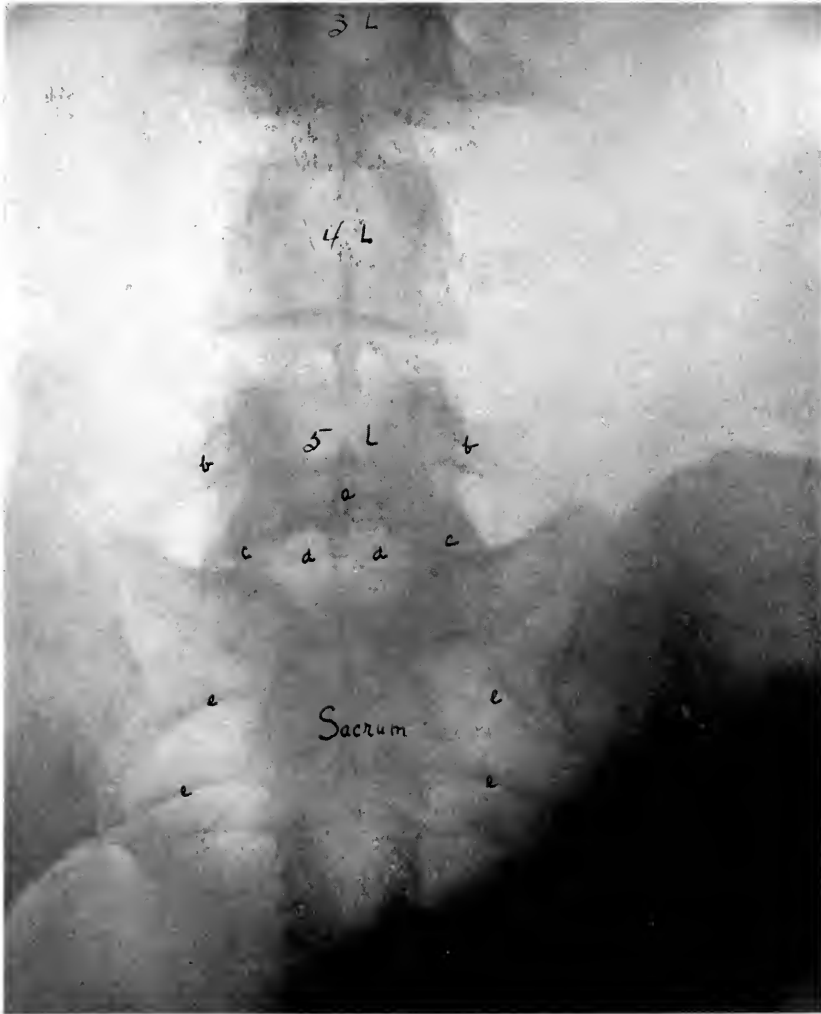


FIG. 1.—Appearance of the fifth lumbar vertebra when the central rays of the X-ray tube pass through the lumbo-sacral region. The intervertebral space between the last lumbar and the sacrum is visible and limited laterally by the articular process. The fifth lumbar, like the other lumbar vertebræ, is quadrilateral. Its spinous process is represented by a dense shadow in the middle of the body: a, spinous process; b, transverse process; c, articular process; d, intervertebral space between the fifth lumbar and the sacrum; e, transverse sacral ridges.

sponding parts of the sacrum. The fifth lumbar vertebra is well above and quite distinct from the sacrum.

If the tube is opposite the dorsal vertebræ, the appearance in the lateral view is the same as that just described, except that the shadow of the sacrum is usually hazy and the outlines of the sacrum are often indistinguishable.

The antero-posterior view (Fig. 2) shows a totally different picture from that described above. All the lumbar vertebrae except the last appear rectangular. The area occupied by the fifth is diminished. In this space one sees two oblong masses joining medially at an obtuse angle, and forming the



FIG. 2.—Appearance of the fifth lumbar vertebra when the central rays of the X-ray tube pass through the dorsal region. All that we see of the fifth lumbar is its posterior arch. Note the laminae, a, and the spinous process, b. The body of the fifth lumbar is not seen nor is the intervertebral space between the body of the fifth and the sacrum visible. When the tube is held lower down a part of the body of the fifth lumbar is brought into view. The radiogram of the fifth lumbar vertebra presents many variations between the extreme view shown in this picture and that shown in figure 1, dependent upon the location of the X-ray tube.

posterior arch of the fifth lumbar vertebra. Above this is a faint transverse linear shadow of the upper border of the body of the fifth lumbar; the transverse processes are very close to and often appear to overlap the iliac crests. The inferior surface of the body of the fifth lumbar and the intervertebral space between this bone and the sacrum are not visible. The upper

part of the sacrum is seen directly below the posterior arch of the fifth lumbar. The body of the sacrum appears smaller than normally because of foreshortening of its shadow. This appearance of the last lumbar and the sacrum is due to the fact that the rays strike the lumbo-sacral region obliquely and pass through both the last lumbar and the sacrum.

*X-ray Appearance in Spondylolisthesis.*—When the last lumbar becomes dislocated anteriorly, it moves downward and forward so that the body of this vertebra overlaps and lies in front of the upper sacral segments and its upper surface faces distinctly forward. The result is that in a front view of the patient, we are looking at the superior surface of the last lumbar vertebra and at the anterior surfaces of the sacrum and the other lumbar vertebræ. The shadow of the last lumbar will then show the body, transverse processes, laminæ, spinous process and spinal foramen. The body of the last lumbar vertebra will overlap the upper part of the sacrum and its spinous process will lie unusually close to the fourth lumbar vertebra. The other lumbar vertebræ will appear as rectangular masses and the sacrum triangular as usual. Therefore, when in an X-ray picture of the lumbo-sacral region we see an appearance as described above, namely one in which the entire outline of the superior surface of the last lumbar vertebra is seen, while the other lumbar vertebræ appear quadrilateral, then a diagnosis of forward dislocation of the last lumbar vertebra is justifiable. Of course in a clear lateral view the presence of the shadow of the body of the last lumbar in front of, instead of above the sacrum, makes the diagnosis absolutely positive. But as it is difficult and maybe impossible in a very large or obese individual to attain a good lateral view, while it is practically always possible to obtain a clear antero-posterior view, the appearance in the latter position is of prime importance.

*Etiology.*—The text-books, especially those on obstetrics, have taught us to believe that this condition is almost always found in women, and is due to a congenital defective development of the lumbo-sacral region, and to marked stretching of the ligamentous structures incidental to pregnancy and parturition. Study of the accident cases, and especially more extensive and expert use of the X-ray machine, show that spondylolisthesis occurs comparatively often in men. Of eight cases that I have seen in the last few years, one was in a girl, and the others in adult males. In all of the males there was a distinct history of trauma preceding immediately or by some weeks or months, the onset of symptoms. This raises the question of the etiological relationship between trauma and the dislocation. It has been argued by some that such a severe lesion as spondylolisthesis could hardly be the result of the degree of trauma which is usually mentioned in the history. In my own three patients the condition followed a direct blow on the back, as in a fall, in two cases, and a sudden strain resulting from an unexpected load being thrown on the shoulders in the other. In all the cases reported by Doctor Darling from the orthopædic services in the Hospital for Ruptured and Crippled, there was a history of injury direct or indirect at some time prior to the onset of symptoms. There is no doubt in my mind that there

probably is some developmental defect in the lumbo-sacral region affecting the body and more particularly the ligamentous structures in all these cases. I believe, however, that trauma is the chief factor in the etiology of this type of dislocation, granting that the individual may be anatomically predis-

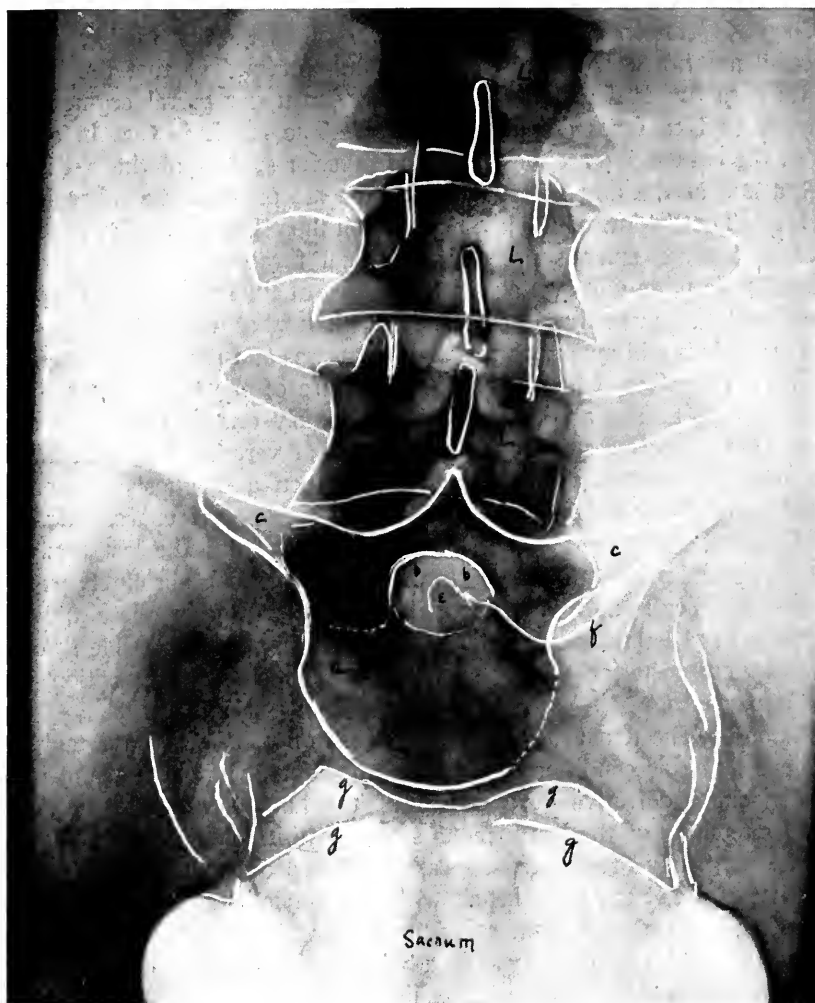


FIG. 3.—Spondylolisthesis. The fifth lumbar vertebra is seen below the fourth lumbar and in front of the upper sacral segments. In the shadow of the fifth lumbar are seen the markings of its superior surface, namely: a, the body; b, the neural foramen; c, the transverse processes and d, the spinous process. The other lumbar vertebrae appear rectangular. e, Spinous process of the first sacral segment; f, upper border of the sacrum; g, transverse sacral ridges.

posed to such a lesion. In a previously reported case,\* the patient, a very intelligent man, was sure that before the injury and onset of symptoms he did not have the hollow above the sacrum which was visible and palpable at the time of my examination. The case to be described had no symptoms referable to his back up to the time of his accident, although for many years he

\* Kleinberg, S.: Archives of Surgery, July, 1921, vol. iii, pp. 102-115.

## SPONDYLOLISTHESIS

had continued at laborious work. When a lesion and disability follow an injury, it is proper to attribute to the injury a large measure of responsibility for the lesion. And while I am willing to concede that the injury described in these cases would not or might not cause a dislocation in a so-called normal spine, yet it must undoubtedly be responsible for the sudden appearance of the lesion in a susceptible individual.

*Case Report.*—J. C. Male, age sixty years, was injured January 19, 1922. He fell from the seventh story of a building on which he was working. There is no history as to how he landed on the ground. He was taken to a hospital where a diagnosis of fracture of some ribs and rupture of the urethra was made. He was confined to bed for about three months. During this time he had pain in the back, but this was not very distressing and little attention was given to it by the patient. When he began to walk about, he found that the backache persisted and was aggravated by all motions of his body. The pain was in the lower part of his back and radiated down both thighs.

Examination showed that he walked without assistance and without a limp. The back was symmetrical and the spine in the median line. There was a shallow groove above the sacrum, evident but not marked. There was persistent tenderness at the lumbo-sacral junction. All the motions of the spine were restricted and painful.

The X-ray picture, Fig. 3, shows the typical findings. The outlines of the vertebræ and sacrum were intentionally emphasized by me in the plate sent for a copy so that the lesion might be easily seen. The second, third and fourth lumbar vertebræ appear rectangular, the transverse processes are seen projecting laterally on either side and the spinous processes are in about the middle of each vertebra. The fifth lumbar vertebra is seen lying in front of the upper part of the sacrum and its upper surface is distinctly outlined. Instead of the vertebra appearing rectangular as do the others, there is a crescentic outline of the body of the vertebra; the transverse processes lie unusually close to the lateral masses of the sacrum and the iliac bones; the posterior arch is very distinct and the spinous process is above its normal position and very near to or perhaps in direct contact with the fourth lumbar. In the middle of the spinal foramen of the fifth lumbar is seen a shadow which is undoubtedly that of the spinous process of the 1st sacral segment.

The chief points of interest in this case are a history of an injury, persistent pain in the lower part of the back, tenderness over the lumbo-sacral region, a hollow above the sacrum, limitation of motions of the spine and a characteristic X-ray appearance.

The occurrence of another case of spondylolisthesis in a male serves to direct our attention to the apparently greater frequency of this lesion among men, particularly laborers, than we have heretofore believed. There can be little doubt that in this patient as in the other two reported by me, trauma played a very important rôle in the causation of the dislocation. As the diagnosis can be made positively only from the X-ray findings, and particularly in view of the fact that the physical signs in most cases simply spell an injury of the back, without any guide to a more accurate diagnosis, this case demonstrates the importance and necessity of careful and competent radiography in all lesions of the back.

---

† Osgood, Robert B., *Journal of Industrial Hygiene*, July, 1919, vol. i, No. 3, pp. 150-57.

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting Held November 22, 1922*

The President, DR. JOHN A. HARTWELL, in the Chair

## TUBERCULOSIS OF CHEST WALL

DR. HUGH AUCHINCLOSS presented a man sixty-two years of age who at twenty-five, thirty-seven years ago, suffered a Neisser infection. No history of lues. At thirty-five, twenty-nine years ago, pneumonia, but a certificate made out by his doctor for insurance benefit was signed "phthisis." At fifty-eight, in 1918 had influenza with bad cough for three months. Controlled after three weeks' treatment. Six months ago had a temporary recurrence of cough. Three months ago soreness developed in left side, and two months ago noticed a small lump over region of fifth rib in anterior axillary line. Examination showed a thin, wiry man of 124 pounds, who looks as if he had lost weight. There are subcrepitant râles at both apices and in first interspace on left side. There are occasional râles at both bases. Breath sounds, voice, fremitus and resonance are not very markedly changed. In anterior axillary line over fifth rib is a fluctuating, slightly tender swelling, not attached to skin, not pulsating and fixed on chest wall. X-ray shows an irregular mottled area of shadow suggestive of calcification of pleura, red blood cells 4,200,000, hæmoglobin 80 per cent., leucocytes 8200, polymorphonuclears 75 per cent. Blood urea, uric acid and sugar are normal. Urine is quite negative. Blood Wassermann: Chol. +++++, Alc. +++++. Several examinations for tubercle bacilli in sputum have been negative. Aspiration of abscess: Grayish, caseous-appearing material containing much cellular debris. No organisms seen.

Operation.—October 29, 1921. Local anæsthesia. Abscess excised and about 12 cm. of 4th and 5th ribs removed with intercostal muscles. The upper margin of the 5th rib was slightly concave as though there had been some decalcification, but this seemed a small lesion compared to that on either side of it. The pleura had been changed to a firm sheet of smooth, calcified, possibly ossified material that could be tapped on with an instrument, producing a resonant tympanitic sound, due to the subjacent lung. A sinus from the abscess cavity only about 0.5 cm. in diameter led to the surface of this sheet of calcium at the level of the 5th rib and was attached to a very small punctate depression that would not admit the end of a probe. The wound was closed after smearing in a small amount of iodoform and splitting the pectoralis major so as to draw it across the sheet of calcium, suturing it to the serratus magnus. Tubercle bacilli were found in the pus from the abscess. Discharged nineteen days after operation. Diagnoses: Tuberculous abscess of lat-

## SUPPURATIVE ARTHRITIS AND OSTEOMYELITIS

eral costal region; chronic pulmonary tuberculosis, quiescent; syphilis. Wound entirely healed, good scar. December 5th, one month. Letter received stating sinus with watery discharge had appeared. Gained six pounds. February 21, 1922, four months. Very small sinus—working, March 21st, five months. Still a tiny sinus that crusts over. April 29th, six months. Treated with bismuth paste in Boston. "Definite improvement is apparent." October 27, 1922, twelve months. Been treated in Massachusetts General Hospital, Out Patient Department most of summer. Sinus did not heal but it was kept clean and in good condition. November 4, 1922, twelve months after first operation, under local anaesthesia, the sinus was excised, the old incision reopened, the tissues pushed away from the plate of calcium and the calcium removed with the exception of a small amount well posteriorly. It lay over the lower part of the lung, the diaphragm and the outer portion of the pericardium, all of which structures were separated from it by sharp and blunt dissection. Slightly thickened pleura beneath it was opened in one place and normal looking blue lung visualized. The lung did not collapse to any great extent. No tubercular tissue was evident. The wound was sutured but a thin discharge occurred with small sinus formation. This has improved, the sinus being smaller and the discharge lessening, and, inasmuch as well nourished soft parts are now in contact one with another, it is probable that it will close. The sinus and calcium deposits are apparent in the specimen.

This patient was shown before this Society October 26, 1921, in connection with a paper on Tuberculous Abscesses of the Chest Wall (*ANNALS OF SURGERY*, Vol. lxxv, April, 1922, p. 416) as Case IX. He demonstrated what large amounts of calcium may be deposited in such cases and how the foreign body calcium plaques may interfere with healing. This is also a follow-up interval result on a case which when shown a year ago had not then been operated on.

DR. ALLEN O. WHIPPLE considered that this case comprised a distinct group differing from other cases of tuberculosis of the chest wall in that the ribs are not involved. In studying this group of cases, it would seem to be primarily a tuberculous lesion of the pleura and not of the ribs. A great many of these cases seen late show a secondary infection, but if seen early they have no sinus and afford an opportunity for complete removal of the tuberculous tissue, and when closed without drainage heal by primary union.

## SUPPURATIVE ARTHRITIS AND OSTEOMYELITIS

A second case, presented by Dr. Hugh Auchincloss, was a boy, twelve years old, who on April 9, 1919, struck inner side of left knee. Had had occasional sore throats in the past. His knee became increasingly painful, and on admission to hospital he was slightly cyanosed and dusky, pulse was rapid, tongue coated, and he appeared septic. Right tonsil was large and red, left tonsil smaller and also red, crypts not filled with exudate. No cardiac murmurs. Left lower first molar carious. The region of the left knee was swollen, slight bluish, red tinge over inner

aspect of lower end of femur associated with marked tenderness with its maximum point at the upper part of the condyle. There were all the signs of fluid in the knee-joint with moderate tenderness. The leucocyte count, 14,000, 83 per cent. polymorphonuclears, the day before had risen slightly to 17,400, 84 per cent. The X-ray showed the slightest rarefaction above the inner condyle of the left femur just above and close to the epiphyseal line. (Fig. 1.) Blood cultures taken before and after operation were both positive for hæmolytic staphylococcus aureus. Temperature 103.4°, pulse 130, respirations 28.

Operation.—April 15, 1919, six days after onset of symptoms. Aspiration of knee-joint of 30 c.c. turbid purulent fluid, containing hæmolytic staphylococcus aureus, was done. An incision along inner condyle was made, and after cutting through the musculo-aponeurotic layer, a few drops of brownish thin pus was found coming from the depths, as from bone. A cavity containing not over 2 c.c. of pus and softened cancellous bone was found above the upper part of the internal condyle. No further extension could be found and the wound was packed with iodoform gauze and a catheter to allow of introduction of Dakin's solution. Culture of pus from bone abscess cavity showed hæmolytic staphylococcus aureus. Six blood cultures taken in eleven days were positive for hæmolytic staphylococcus aureus. The knee-joint was aspirated of purulent fluid containing staphylococcus aureus on culture six times in nineteen days, washed with saline five times and saline preceded by 1 per cent. carbolic three times. Twenty-five days after the first operation an abscess cavity containing about 50 c.c. of pus was opened beneath the extensor muscles immediately in front of the bone. The wall of the inner bursa of the joint could be seen perfectly and no communication found. His temperature became practically normal on the 30th day and he was discharged July 16, 1919, after thirteen weeks in hospital. But very little active motion was possible with this boy until about the fifth week, during much of this time slight traction was maintained.

He reported to the out patient department after having been fitted with a knee brace that allowed him to walk and run about and even kick a football. However, a persistent sinus remained, and it was not until March, 1920, that he was readmitted to the hospital. A small incision was made over the sinus and a sequestrum removed, whereupon the wound firmly closed within the next few weeks. There is a moderate varus deformity due to the effect of the lesion on the ossification zone above the epiphysis, otherwise there is a useful knee with complete flexion and extension.

This case is presented because he demonstrates a severe suppurative arthritis of the knee-joint associated with bacteriæmia and a small bone focus, seen early in the course of the disease, that had had his knee-joint aspirated but not drained. It is perhaps wisest for attention to be paid more to the lesion in the tissues immediately outside a joint rather than to the joint fluid. In dealing with an early case such as this, adequate and immediate drainage of the focus outside the joint is the essential feature. Aspiration of the joint, even though





FIG. 1.—Case A. R. Shows site of bone lesion as shown five days after onset. Slight rarefaction and uneven periosteum above the ossification zone, separating the diaphysis from the epiphysis.



## TRANSPLANTATION OF TENDON

it has to be repeated was done successfully in this case and has been done successfully in others and is probably a good procedure. Drainage of such a joint is probably unnecessary. The process has not gone far enough and the time has been short for necrosis to any extent to have occurred in the actual lining of the joint. Where necrosis of the actual lining of the joint has occurred to any marked degree, drainage is probably better than aspiration. In later cases or in cases that have become infected through trauma or gunshot injury with presence of foreign body for any length of time, the joint lining is seriously damaged, and in these cases free drainage is probably always indicated. By drainage is meant adequate opening of the joint cavity, but placing of no drainage into the joint cavity, and taking such measures, of which active motion is the most desirable, to insure the passage of exudate from within the cavity out, in as free a manner as possible. Whether the joint is aspirated or drained, the principle of active motion is of course most important in securing early and complete function, and it should be encouraged in every possible way, even though the patient refuses to coöperate. But whether the joint cavity be drained or aspirated the main feature is the adequate treatment of the focus immediately outside the cavity.

DR. CLARENCE A. McWILLIAMS thought it would be wiser to open a septic knee at once in view of the bacteriæmia. After aspiration there is no external drainage, consequently there must be absorption of organisms into the general circulation which, in a severe case, might turn the tide against the patient. Doubtless Doctor Auchincloss took the type of the organism into consideration in persisting in aspiration. Had it been streptococcus he probably would have opened it at once. This case seemed to the speaker to have lax ligaments which possibly might be explained by the repeated distentions of the joint. In addition, opening the joint would have allowed active motions to be instituted at once.

DR. ROYAL WHITMAN considered that the lax ligaments might be explained by the incongruity of the articular surfaces with consequent outward deviation when weight was borne. This might be corrected by osteotomy, but as there was apparently no functional disability this seemed hardly indicated at present.

Doctor Auchincloss in closing replied that osteotomy had been considered, but the problem was whether to do it now or later on after he had attained his growth. It had been thought wiser to wait and then see if it would be necessary.

## TRANSPLANTATION OF TENDON

The following case presented by Dr. Hugh Auchincloss was a girl, six years old, who when four years old, April, 1920, cut hand with glass at base of left middle finger. She could apparently move her finger normally at the time. The wound was dressed and nothing much thought of it. Two days later her brother came down with diphtheria. On the third day she was given an immunizing dose of diphtheria antitoxin, and that night her temperature was 103°. There was considerable question as to whether this was due to

the hand or the antitoxin. On the fourth day the hand was incised by the physician in charge and a surgeon was called on the fifth day. He incised the proximal phalanx at once, and on the eighth day the middle phalanx. Three weeks later another incision was made to examine the tendon. After two months all the wounds were healed. Four months later she was seen by Doctor Blake in consultation, who thought that if the tendon had been cut it might be possible to do a tenorrhaphy after freeing the distal portion were it found adherent. The family physician informed me, however, that the tendon had

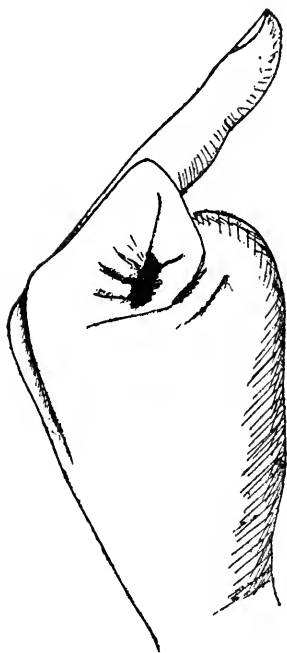


FIG. 1.—Showing the deformity.

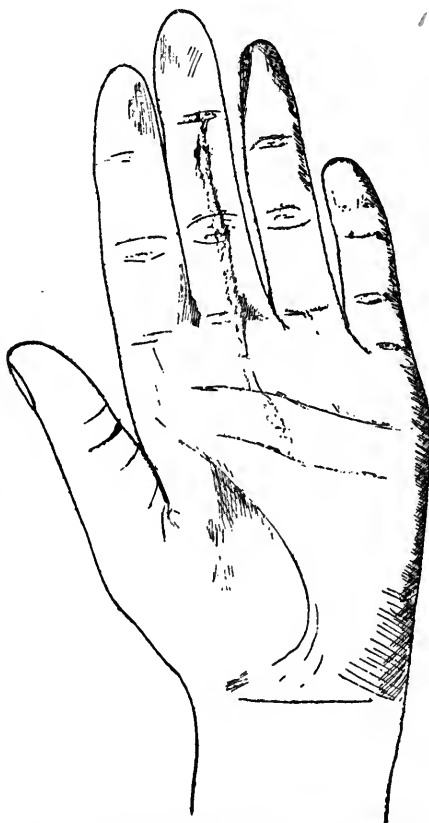


FIG. 2.—Showing extent and character of scar, before tendon transplantation.

been exposed in the wound, that he was sure it had not been cut at the time of injury, that a true suppurative tenosynovitis had occurred, and that the tendon had not sloughed out.

When first seen, four months later, in October, 1920, there was free motion at the metacarpo-phalangeal joint. The finger was straight. (Fig. 1.) There was no active motion whatever in the interphalangeal joints though they could be freely moved passively. A scar extended from the distal flexion crease of the finger to the middle flexion crease of the palm. It was slightly to the ulnar side of the midline. (Fig. 2.) The problem was, accordingly, one not infre-

quently seen, of adherent flexor tendons to the digital sheath. In making a fist the proximal phalanges were in alignment, but the middle and distal phalanges of the middle finger stuck out in full extension. It was decided that it might be wise to let more time elapse between the closure of the wounds and any plastic attempt, so that the operation was performed January 3, 1921, about seven months after the wounds had closed, and nearly twenty-three months ago, with the patient's family fully aware that I considered the chances of success exceedingly small.

Under ether anæsthesia, with a tourniquet about upper arm, incision was made along the side of the finger to the web and thence into the palm and deepened to sheath, sparing the digital vessels. The flexor tendons were adherent and the profundus particularly so in its course over the middle phalanx. The vaginal ligament with its function of a phalangeal annular ligament, over the proximal phalanx was gone. It was just possible to make out dense bands corresponding to the vaginal ligament of the middle phalanx and these were preserved. Old scar tissue fibres were all that corresponded to the transverse metacarpal ligament in the palm. Both flexor profundus and sublimis tendons were then removed from the distal interphalangeal joint well into the palm of the hand, by a careful dissection, endeavoring to preserve every strand that might be of use to serve as a vaginal ligament. This was done by sharp dissection and with tendon strippers as recommended by Doctor Bunnell. An incision over the extensor longus digitorum of the left fourth toe was then made and about seven centimetres of the tendon was removed, not only in its sheath but also with the deep fascia covering the sheath that was incised for about one centimetre on either side of the tendon. The lateral flaps thus made were sutured together on the under, or plantar, surface of the sheath. The tendon readily moved up and down within a synovial sheath and entirely surrounded by fascia. Fine Stiles' linen thread was laced into the ends of the tendon and the tendon then attached to the base of the terminal phalanx in the finger by means of the stub of the removed profundus tendon that had been split to receive it. Before doing this a specially constructed silver tube with obturator was passed beneath the remains of the vaginal ligament over the middle phalanx and the obturator withdrawn. Traction sutures were placed in the fascial-synovial investments on either side of the end of the tendon where the suture had already been laced in, and all three sutures were then passed through the canula and the tendon with its synovial and fascial sheaths drawn through and the canula removed, thus avoiding trauma to the tendon and its investments. The proximal end was united to the combined ends of the flexor tendons by lacing the ends with Stiles' linen thread after Bunnell's technic and the fascial and synovial investments drawn down as far as possible so as to cover the anastomosis. A slip from the neighboring extensor brevis was united to the distal cut end of the extensor longus tendon to the toe and both wounds sutured with extra fine silkworm gut. The finger was put up in flexion. Though it took over three hours there was very little reaction and the wound healed promptly with narrow scar. Motion was

begun on second day. Only the slightest range at first, but as soon as wound healing had been pretty well established, the range was increased. It was extremely disappointing, however, to find that she had no definite motion in the interphalangeal joints.

The main problem was then to provide a way for the child to call the muscle cells of the two tendons to that finger into voluntary action.

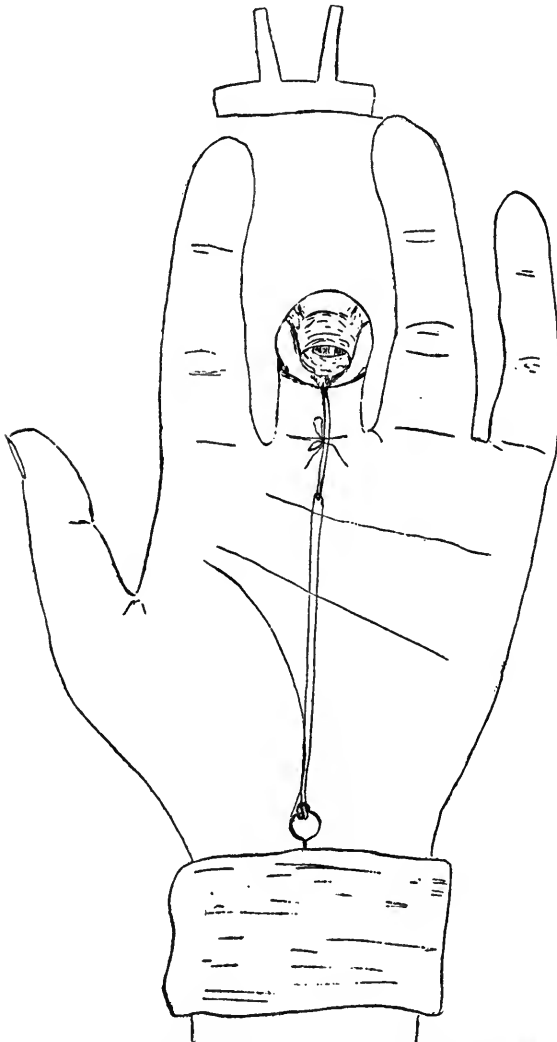


FIG. 3.—Showing application of elastic traction apparatus.

Electricity, massage, vibration, various occupations were considered, but finally it was decided to make the attempt in the following manner: By means of an elastic band stretched from adhesive plaster stuck about the tip of the finger to a wristlet (Fig. 3), the finger was held in flexion by elastic traction. By extending her finger against this elastic traction, an act she could readily do, she was compelled to contract the muscle cells of the two tendons that had been sewn to the transplant. It is simple for anyone to demonstrate to himself that when finger extension is carried out under resistance that the flexors contract as well. Such an apparatus was worn during the day and removed at night through the most persevering coöperation

## BLOOD TRANSFUSION

than it should have been, that a period of taking up slack had been gone through and that if now function to any extent had been gained that with the years of growth combined with function ahead of her it is possible this finger may eventually compare favorably with the rest.

She now has almost complete flexion in the proximal interphalangeal joint though there is but little, if any, in the distal interphalangeal joint. It was thought that the principle of elastic traction was of great value in this case.

DR. SEWARD ERDMAN asked Doctor Auchincloss how he explained the complete inability to flex the distal phalanx; and whether or not this lack of flexion might be due to adhesions in the successfully transplanted tendon, which might be released by a further operation.

In reply, Doctor Auchincloss said that he rather thought that the reason was due to the technical difficulties in making an attachment of the transplanted tendon in its sheath to the short stub of profundus tendon attached to the base of the phalanx. This had to be done practically over the joint and the small area in which to work, because of the size of the finger at four years of age, left little leeway for a refined anastomosis of any sort.

## BLOOD TRANSFUSION

DR. EDWARD W. PETERSON read a paper with the above title, for which see *ANNALS OF SURGERY*, vol. lxxvii, page 364.

DR. RICHARD LEWISOHN expressed his accord with Doctor Peterson as to the value and limitations of blood transfusion. He was not, however, in accord with Doctor Peterson in his estimate of the value of the different methods, and he felt he should not let pass unchallenged Doctor Peterson's claim as to the superiority of uncitrated blood over citrated blood. There is plenty of proof that the immediate and late effects following the citrate method are as good as those following transfusion of uncitrated blood. Claims of biologic superiority of uncitrated blood are based on a recent publication of Unger. Unger's first contention was that citrated plasma has anticomplementary power. His second contention was that sodium citrate increased the fragility of the red blood cells and therefore citrated blood could not be used in hemorrhagic diseases. He further contended that the phagocytic index of the leucocytes is decreased by sodium citrate. Mellon, Hastings and Casey have stated that their results were diametrically opposed to those of Unger. According to these authors citrated plasma has no anticomplementary power, and red blood cells and leucocytes are not affected by sodium citrate.

Referring to the question of chills following transfusion, Doctor Lewisohn said that it is usually claimed that the sodium citrate is followed by many more chills than all the other methods. At Mt. Sinai Hospital, from January to November, 1922, thirty-four citrate transfusions were followed by eight chills, and twenty-nine Unger transfusions by ten chills, making twenty-three per cent. of chills for the citrated method and thirty per cent. of chills for Unger's method.

DR. CHARLES G. HEYD considered that too much was expected from blood transfusion. When it was properly indicated it was an ideal procedure. In cases of acute sepsis it was not indicated and the surgeon was under the necessity of combating a strong prejudice in the minds of the relatives of the patient as to the value of blood transfusion in these conditions. In a number of cases of acute sepsis the speaker had found blood transfusion of no value as a curative agent and only slightly so from the partial stimulation it gave. There is a very large financial and social aspect in the prevalent idea that blood transfusion should be used in all cases of acute sepsis. It only entails expense to the family and does not in any appreciable way benefit the condition. At the present time transfusion is independent of technic and of operator. It is such a common practice in all general hospitals and the procedure so simple that the senior internes can be expected to do it. Doctor Heyd congratulated Doctor Peterson upon his carefully determined indications for blood transfusion. A special point of danger should be emphasized in that it is possible to activate hemorrhage by massive transfusion, and that the time of transfusion is equally important with the amount of blood to be transfused. Another point of importance is that certain donors have a higher degree of coagulability than others. In cholemic states a transfusion before operation is better than two or three afterward. As to the merits of citrate and whole blood transfusion, they both have their places. The latter would, however, seem to represent the ideal transfusion. There is a wide feeling for both kinds of blood transfusion, and emphasis should be placed upon the indications for transfusion and the optimum time for giving it rather than upon the technic of method.

DOCTOR PETERSON, in closing the discussion, said that in spite of the rather well understood indications for blood transfusion, the operation was done many times when it could do no possible good. It was frequently suggested, in hopeless cases, after other measures had failed, in the hope that it might be of benefit. A procedure which lends itself so readily to commercial exploitation is apt to come in for a certain amount of abuse. As to the methods of whole blood and citrated blood the speaker, not being a serologist, had to rely on his own clinical results for his impressions and conclusions. He had used citrated blood in about 100 instances and had returned to unmodified blood transfusions because, in his own experience at least, there seemed to be no doubt as to the superiority of the latter. Bernheim, who had charge of the transfusion work in the A.E.F., had recommended citrate transfusion without qualification, in his book, but since then has modified his views and makes the following significant comments:

"We must not be blind to the fact that the sodium citrate blood transfusion possesses certain obscure but none the less inherent features that are not only embarrassing to the physician but most uncomfortable and even dangerous to the patient. Chills and fever and profound shock have never helped anyone, and to ignore the danger of these sequelæ, merely to note their occurrence



## BLOOD TRANSFUSION

without vouchsafing a careful consideration of their eventualities, is little more than admitting a mind closed to certain embarrassing features connected with the procedure."

I would not have you think for one moment that this is an attempt to belittle the value of the citrate ransfusion. No one realizes better than I how much that has meant to the medical profession and to humanity at large. But it is necessary to recognize the fact that there are definite limitations to this method of giving blood, and that failure to observe these limitations has caused unnecessary loss of life.

## CORRESPONDENCE

### TRACTION APPARATUS FOR OPEN REDUCTION OF FRACTURES

EDITOR ANNALS OF SURGERY:

Sir:

THE open reduction of any fracture is justly regarded a hazardous procedure to be undertaken only after attempts at closed reduction have failed. In spite of the advances made in the treatment of fractures, there remains a certain although diminishing number of fractures which require operation. In the operative treatment of these, certain principles have been well established, *i.e.*, the necessity of the most rigid aseptic technic, of avoiding all

trauma to the tissues in the reduction of the fracture, and of preventing so far as possible the introduction of fingers and instruments into the wound.

In this clinic open reduction has most often been necessary in spiral fractures of the tibia. In some of these we have had great difficulty in bringing the two fragments into apposition even with the use of Lowman clamps, Lane tongs and a Lane skid; and, often, after the fragments have been

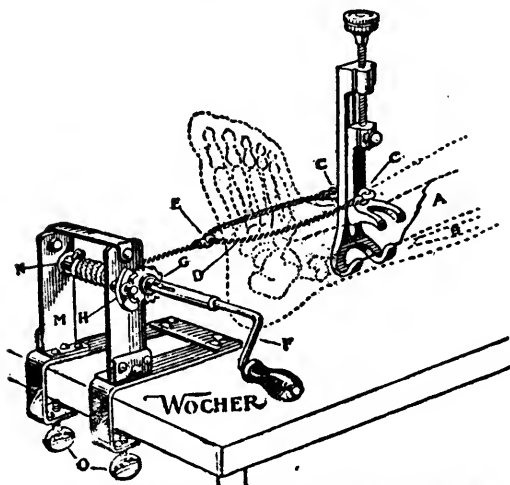


FIG. 1.—Appearance of traction apparatus described.

brought into apposition, with what we believed a considerable amount of trauma to the tissues, we have found it difficult to plate or place a Parham band because of interference by the instruments required to hold the fragments in place.

For the twofold purpose of avoiding as far as possible all trauma to the tissues and of eliminating from the wound all instruments which might interfere in the fixation of the fracture, the instrument here presented was devised. It combines great traction power with the ability to hold the fragments in apposition.

The windlass "M" (Fig. 1) is made of steel and is 3.5 inches high and 2.5 inches broad, so that it can be readily sterilized. It is composed of the uprights and reinforcing bands as shown in the illustration. The steel cylinder "N" revolves by turning the handle "F." The ratchet "G" and

## CORRESPONDENCE

brake "H" prevent the cylinder from unwinding after traction has been obtained. In the cylinder "N" is an open-eyed screw into which one end of the wire cable can be hooked. The other end of the cable is hooked to the cable "E" which encircles the foot, the two ends of which are hooked into the open-eyed screws "C" of the Lowman clamp. These two open-eyed screws "C" are placed on the *movable* part of the clamp at points opposite each other. The line of traction therefore is always parallel to the shaft of the bone, no matter what the size of the bone, and the two screws are always exactly opposite each other.

In regard to the method of procedure, the accompanying drawing is self-explanatory. The operating table is slightly inclined with the head down, in order that the patient will not be moved when traction is applied. This is obviously quite important. The bone is then isolated well above and below the line of fracture and the clamp applied to the lower fragment, and screwed down tightly. The windlass is then clamped to the end of the table, the cables applied as in the illustration, and by turning the handle "F" the fractured ends are pulled into approximation. They are held in this position by the brake on the windlass until a bone plate or band, as the case demands, is applied. The traction is then released gradually, the clamp removed, and the wound closed in the usual manner.

With this technic, trauma to the tissues, which is unavoidable when reduction is attempted by placing tongs and using a skid, is largely eliminated.

An added advantage of technical importance is that while the upper fragment is fixed, the lower fragment can be easily rotated at the same time that the desired amount of traction is maintained. This is not true when a turn-buckle is used, because both clamps rotate together, often necessitating the readjustment of the clamps before the desired amount of rotation of the lower fragment is obtained.

CHARLES Y. BIDGOOD, M.D.,  
BURR N. CARTER, M.D.,  
*Cincinnati General Hospital,  
Cincinnati, Ohio.*

## BOOK REVIEWS

BRAIN ABSCESS. ITS SURGICAL PATHOLOGY AND OPERATIVE TECHNIC. By WELLS P. EAGLETON, M.D. MacMillan Company, 1922.

The author states his belief that a positive diagnosis of brain abscess should be possible; further, that it is possible to ascertain its location in a large proportion of cases; and also that from the history obtained, especially in relation to the time of existence and date of the chill, or even the first vague chilliness, it is possible to determine whether the abscess is encapsulated. A thorough history is vital. It may shed light on the date of the first "vague chill" which has become almost axiomatically the sign of the time when infection passes the barrier of the dura and reaches the piaarachnoid; a matter of extreme importance as suggesting the length of time the abscess has existed; for revealing attacks of uncontrollable vertigo, suggestive as to locating the abscess or tumor in the cerebellum; for determining the previous presence of periods of a "dreamy state"; of previous or present aphasia, temporary or long-continued; complete motor, sensory or "naming" ataxia; gradual or sudden hemiplegia; of appreciable intervals between the loss of power in hand, leg and face; or an unrecognized hemianopsia. Some or all of these always occur during the development of brain abscess.

Hemorrhage is one of the serious drawbacks to the comfort of the brain surgeon, and to the control of this much space is devoted through various sections of the book. Hemorrhage is less troublesome in brain abscess than in brain tumors where the increased intracranial pressure produces excessive general oozing. The author follows Cushing in the method of dividing the vessels of the dura, closing them with silver wire "clips" as he proceeds, the aim being to rigidly prevent the exudation of blood into the piaarachnoid.

The author regards the "stalk" of a brain abscess as always a late manifestation. It is nature's effort to evacuate an encapsulated abscess through the original site of the infection. Favoring this theory are the numerous cases recorded of the spontaneous evacuation of pus through the extension of a stalk to, and a secondary necrosis of, the dura, followed by cure of the abscess.

The author recognizes that in chronic intracerebral abscess of the temporal lobe secondary to infection of the brain through the tegmen tympani, more recoveries occur by an operation following the track by way of the mastoid antrum, than by cutting through the uninfected dura over the external surface of the temporo-sphenoidal lobe; because in the first case the area of protective adhesions already built up by nature can be utilized and its track followed to the abscess cavity.

The mechanical difficulties of draining abscesses of the brain are compared to those of effort to withdraw the entire yolk of an egg and still leave

the surrounding white with the least possible disturbance of the latter. The interior of the brain is a semisolid mass of nerve cells and glial tissue and only held in shape by the surrounding piaarachnoid envelope, lacking muscular structure which, by contracting, aids the expulsion of abscess contents in other parts of the body. Hence the author makes the following axiomatic observations: The nearer the pus approaches the density of the surrounding cerebral tissue, the greater the difficulty of complete evacuation. The firmer the envelope, the greater the possibility of entrance into the abscess cavity of an instrument which can insure drainage, cleansing and obliteration of the cavity. Pus of thin consistency can be more completely evacuated than thicker pus.

The author lays stress on the importance of complete evacuation of a chronic adjacent intracerebral abscess of the middle fossa at the first operation. It is the only chance of success, or, in the words of the author, "the surgeon, in chronic brain abscess with a capsule, has but one major chance to combat infection, namely, *at the time of the primary operation.*" He quotes two clinical observations in support of this statement as follows: "If following an operation for brain abscess the disappearance of the symptoms is *accompanied by almost complete cessation of the discharge*, complete primary evacuation-relapse and refilling of the abscess cavity but rarely occurs; secondly, on the other hand, continuation after the first few days of a profuse discharge from the drainage tube—incomplete primary evacuation—frequently results in recurrence of the symptoms, associated with a sudden cessation of the discharge; cleansing of the tube showing that the cessation of the discharge is not due to plugging of the tube, but that a new area of encephalitis is present which is unconnected altogether with the region previously drained."

The author does not condemn puncture of the dura for evacuation of a brain abscess, in that it gives a large proportion of recoveries. Nevertheless, it has the disadvantage that subtemporal or piaarachnoid abscesses will either be entirely overlooked or imperfectly evacuated. In abscess with a capsule the puncture method will fail. It is recommended, however, in acute brain abscess, provided it results in evacuation of the fluid and the establishment of a "tract."

"A brain abscess with a capsule, if near the cortical surface, should be thoroughly evacuated, its walls inspected and cleansed, and its cavity obliterated, so that on withdrawal of the inspecting encephaloscope, the surgeon should *know* that no recess of the abscess has been overlooked." The author believes that "second" abscesses are always prolongations of the main abscess and united to it. On the evacuation of the pus from the main abscess an obliteration of the entrance to the "second" is usually produced through collapse of the surrounding tissue. The author uses an illuminated headlight and his own modification of the Whiting encephaloscope by which the interior of the abscess is thoroughly examined. The drain is preferably of rubber

tissue. Subsequently to the operation, further drainage of pus is accomplished with a soft rubber catheter (graduated) which must be securely anchored to the margin of the wound. Gravity may be utilized to assist drainage by lowering the head of or changing the position of the table.

After operations on the brain, all purulent material having been evacuated, every surface except the portion which conveys the drainage should be entirely covered. To place dry gauze over an exposed area of piaarachnoid is to invite disaster. The rubber drainage tube or rubber tissue used for a drain is led through dura, bone and skin to the nearest external surface and anchored; the remaining surface is recovered with dura, or if protruding brain tissue prevents, an edge of fascia lata, which most nearly substitutes a dural surface. The wound is best left undisturbed for as long as possible, a few days at least, so that protective granulations may have covered the disturbed piaarachnoid surface before the first dressing. The other recommends that the drain be allowed to become slowly expelled, rather than to repeatedly remove and reintroduce it. As it protrudes, the outer part is cut off and again anchored to the edge of the wound until no further drainage is necessary.

The author defines "adjacent abscess" as one which has occurred by direct invasion of the brain by direct extension, by processes of tissue supuration, thrombophlebitis or perivascularitis, as, for example, from the mastoid antrum, the middle ear, labyrinth or nose, to either one of which it is directly connected by the pathological process. Metastatic abscess is of hæmatogenous origin, having been conveyed from heart, lungs, ear or elsewhere by the blood stream. Metastatic abscess of the brain follows the occlusion of a cerebral vessel by an infected nidus circulating freely within the blood stream; bacterial invasion of the blood stream alone apparently being insufficient to produce brain abscess. This type of brain abscess is sudden in its onset, with violent headache, dizziness and projectile vomiting, apoplecticiform, though perhaps transient.

The great majority of cerebellar abscesses originate from aural infections. The author makes the following surgical classification of cerebellar abscesses. Those situated in or on the anterior surface of the cerebellum; in all of which infection has gained access to the brain through the posterior surface of the petrous pyramid of the temporal bone; and (2) cerebellar abscesses in or on the posterior two-thirds of the lateral hemisphere of the cerebellum, in which infection gains access from the lateral sinus. He plans operation on the following bases: (1) to evacuate the abscess at its nearest approach to the dura; (2) so as to reduce the intracranial pressure, and (3) to prevent excessive cerebral herniation.

One of the surprising things recorded by the author is the large number of cerebral abscesses in which are combined labyrinthitis and sinus infections. Most important in cerebellar abscess is the determination of the seat of the original infection. Hence the extreme importance of investigating the state of the labyrinthine function. The presence of a dead labyrinth, indicated

by non-reaction of the labyrinthine function, is strongly suggestive of the abscess being located in the cerebellar fossa.

The author discusses most interestingly the causes and mode of operation on abscess of the frontal lobe; gives a chapter devoted to hernia cerebri; another to protective mechanism of the brain; others to the diagnosis of brain abscesses in general; to diagnosis of adjacent temporo-sphenoidal abscesses, diagnosis of cerebellar abscess and to complications and results. In three appendices he treats of "Guide for Detailed Neurological Examination," "Analysis of 125 Cases of Cerebellar Abscesses" and "Analysis of 140 Cases of Ruptured Frontal Lobe Abscesses."

The writer of this review would extend to the author his sincere congratulations on the successful completion of this work. It will be read and referred to by surgeons and students as an indispensable source of information on surgery of the brain for a long time to come.

WILLIAM C. BRAISLIN.

**ARTIFICIAL LIMBS AND AMPUTATION STUMPS.** By E. MUIRHEAD LITTLE, F.R.S.C., Eng. Philadelphia, P. Blakiston's Son & Co., 1922.

The question of efficient prostheses for the maimed has become of great moment to the world at large during the past few years. Until the present publication was received there had been no attempt to inform not only orthopædists, but the profession generally what points were necessary to consider in drawing a specification for an artificial limb. The subject has been to all practical purposes completely neglected in our modern systems of surgery, and only that phase considered which instructed the surgeon how to obtain the best type of stump.

The Germans even two years ago had published an encyclopædic work on the subject of artificial limbs, and the author's present work hardly covers such an extensive compilation of facts, even the French antedated this present volume by a handbook on artificial limbs written by Broca and Ducroquet. There has yet to be published any authoritative American work covering the subject. The physician or surgeon usually turns over the patient to a company making such limbs, and either not having any subsequent supervision of the patient or, until having this work to consult, not even knowing what could be accomplished or how best to accomplish it.

The subject is presented most rationally and the author has succeeded in not making the book a compilation of limb-makers' catalogues, although he has used their illustrations freely where it best suited his purpose, employing some two hundred and sixty-seven. The text is lucid, readable and definite, representing the author's experience in the treatment and supervision of twenty-five thousand cases of amputation which have come under his notice chiefly at the Roehampton Hospital.

The question of amputation stumps is thoroughly considered and is followed by a chapter on cineplastic and other procedures for improving their utility. He calls attention to the fact that in arm prostheses, the design and

## BOOK REVIEWS

details of manufacture present the greatest difficulties, and are more important than the fitting of the socket to the stump, while in leg prostheses the converse obtains.

The chapters on arm and leg prostheses are well illustrated, working drawings of the intricacies of these artificial members being shown, as well as many and various appliances which may be attached to them to improve their usefulness.

Reference to various types of limbs necessitated is rendered easy by referring to the Ministerial list of numbers on page 195, which form a series corresponding to sites of amputation of the leg from above downward which are most frequently used, while a similar tabulation is made on page 122 for those prostheses necessary for amputated arms.

The Ministry of Pensions advocates the employment of an alloy of aluminum known as "duralumin" for use in arm prostheses in general, as it appears to have given the best results after exhaustive tests, while the leg sockets are constructed of a material known as "certalmid," a combination of glue, muslin and celluloid, although the wooden socket allows of the nicer adjustment but weighs a little more.

In an appendix one finds a more detailed specification for artificial limbs and directions for making "certalmid" sockets and for fitting the Ministry's light metal leg.

The amount of labor and observation necessitated in the compilation of this volume can not help but be remarked, certainly such a correlation of ideas is greatly needed. To those interested in this type of work, the present edition will prove of the greatest value and it is to be highly recommended, containing as it does the present summation of the observations of one most competent to elucidate a complicated but very pertinent subject.

JAMES T. PILCHER.

### To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

**ANNALS of SURGERY**

227-231 S. 6th Street

Philadelphia, Penna.



# ANNALS of SURGERY

VOL. LXXVII

MAY, 1923

No. 5

## ISCHEMIC FAT NECROSIS\*

BY CHARLES E. FARR, M.D.

OF NEW YORK, N. Y.

FROM THE LABORATORY OF SURGICAL PATHOLOGY, CORNELL UNIVERSITY MEDICAL SCHOOL

FAT necrosis apart from pancreatic disease is generally considered an exceedingly rare condition, while subcutaneous fat necrosis even in pancreatic disease is rather exceptional. The following case, therefore, should be of double value and interest:

*Case Report.*—CASE I.—A. E. P., aged four weeks, was referred to the First Surgical Division of the New York Hospital on December 19, 1912, by Doctor May of the Medical Clinic, for treatment of a paralysis of the left arm and because of certain peculiar subcutaneous tumors of the neck and shoulders.

*Family History.*—Father and mother alive and well. They are Russian Poles but have lived in this country several years. Two living children, both well. One stillbirth, one infant died of summer complaint. No miscarriages. The present child and the stillbirth were instrumental deliveries. No history of syphilis or tuberculosis could be obtained.

*Present History.*—The child was born after a labor of eighteen hours duration and a very difficult and tedious instrumental delivery. It was a vertex presentation: the other details are unknown. On the second day it was noticed that the left arm was completely paralyzed and that there were marked discolorations over the neck and shoulders. These cleared up in a few days and the child appeared perfectly healthy except for the paralysis. It was strong and vigorous and took the breast well. Hospital treatment was sought because of the paralysis of the arm, the parents not having noted anything else abnormal.

*Physical Examination.*—A healthy female child weighing about eight pounds and presenting no evidence of trouble except a flaccid paralysis of the left arm and hand, probably due to birth trauma, and a very slight rash on the face. On palpation, however, a large number of subcutaneous tumors were found over the neck and shoulders, extending as high as the submaxillary region and as low as the seventh rib posteriorly. These tumor masses were of irregular shape and varying sizes from one-half cm. to five cm. in diameter, and for the most part oval in shape, although one or two were sausage-like masses. Their consistency was considerably firmer than the surrounding normal fat. There was no evidence of pain, tenderness, nor any inflammatory signs whatever. The tumors were adherent to the skin, but were freely movable on the underlying tissues. The largest masses were found over the deltoid, supra- and infraspinatus regions. Various diagnoses were considered but the one

\* Read before The New York Surgical Society, February 14, 1923.

finally accepted was multiple congenital lipomata or, possibly, some condition of unaltered embryonal fat.

Under cocaine anaesthesia an oval piece of skin and subcutaneous fat was excised from the left supraspinatus region, including a portion of one of the larger tumors. The wound was sutured and healed by primary union. The child improved rapidly while under observation, although the condition of the left arm showed no change. The multiple tumors were definitely growing smaller when the child was taken from the clinic at the end of four weeks.

*Pathologic Examination, Gross.*—The tissue removed from the shoulder consisted of skin, subcutaneous fat and a portion of one of the larger tumor

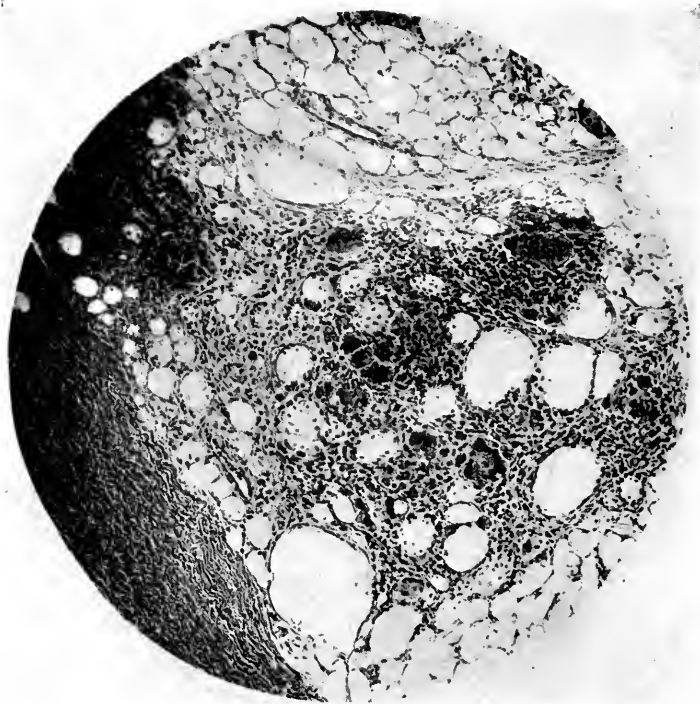


FIG. 1.—Fat necrosis, infant.

masses. Upon section, the tumor tissue was seen to be fairly sharply defined from the surrounding fat, into which it extended about one and one-half cm. in depth. The color was a dull grayish-white, harder than the normal fat, opaque and of homogeneous appearance. The diagnosis at this time was not evident, as the lesion was not unlike a new growth in appearance. Syphilis and tuberculosis were considered but some form of fat tumor was considered more probable.

*Microscopic.*—Part of the tumor tissue was immediately injected into a guinea pig and the rest was sectioned at once by Doctor Elser. Frozen sections were stained with hæmatoxylin and eosin and showed under the microscope a most beautiful picture of subcutaneous fat necrosis in a fairly advanced stage of repair, with considerable round cell infiltration and formation of new connective tissue but more especially the presence of innumerable giant cells of the irritation or foreign body. (Fig. 1.) Everywhere throughout the specimen the

necrotic fat spaces were filled with bundles of fatty acid crystals. In other words the picture was typical of fat necrosis of the type usually considered pancreatic in origin. Sections stained and examined for bacteria showed none present. The pig into which a portion of the tissue had been introduced remained perfectly well for four months and on autopsy showed no lesions whatever.

This case is then one of the very infrequent cases of subcutaneous fat necrosis and is the only one, so far as a careful search of the literature shows, in an infant. Considering the weight and age of the child, it is also probably the most extensive case on record of fat necrosis with recovery.

Stimulated by these unusual findings and by the friendly interest of Doctor Elser, I sought to determine, so far as possible, the origin of the lesion, its frequency and the results. Inquiry was made of numerous pathologists, obstetricians and pediatricists as to similar observations, with entirely negative results, although Dr. Horst Oertel stated that he had not infrequently seen necrosis of the abdominal fat in obese subjects, following laparotomy. Through the kindness of Dr. Edward Truesdell, forty new-born infants were examined at the New York Lying-in Hospital, again with negative findings. It should be observed, however, that none showed evidence of severe traumatism at birth.

Through the courtesy of Professors Elser and Ewing, the attempt was then made to reproduce experimentally the lesions of fat necrosis, by traumatism, in the Laboratory of Surgical Pathology of the Cornell University Medical School.

*Experiment I.*—Sterile normal subcutaneous fat obtained at operation for inguinal hernia in a young child was divided into two portions. One part was placed in a thermostat at 37 C. for two days. At the end of this time, smears in a drop of water showed fairly numerous crystals of fatty acid. The second portion was kept in two per cent. formol at room temperature for 25 days, at the end of which period smears both from the surface and from the interior showed very numerous crystals of fatty acid.

*Experiment II.*—The repetition of the above, using fat from an obese old lady and keeping it ten days at 37 C. Smears showed almost complete change into fatty acid crystals and fine fat droplets.

From these two simple procedures, which of course are not original, it may be concluded that fat is a very unstable substance and that it readily splits into fatty acid and glycerine without any extraneous aid. It should be noted that no macroscopic blood was present in the fat. The presence of a fat splitting ferment in the blood as well as in the fat itself has long been known.

*Experiment III.*—A healthy female pig about six weeks old and weighing about twenty pounds was then obtained; its shoulders shaved and the skin and subcutaneous fat traumatised in seven places by means of strong pincers, whose jaws were guarded with rubber to prevent abrasion of the skin proper. A piece of normal skin and subcutaneous tissue was removed as a control as well as one of the traumatised areas. The other pieces of traumatised tissue were removed at subsequent periods as shown below.

(a) Piece of normal fat—careful examination of smears showed no crystals. No evidence of necrosis. This tissue was then placed in 10 per cent. formol and

kept at room temperature for 28 days. A smear from surface scraping then showed an occasional typical fatty acid crystal. From this it may be concluded that fat splitting can take place to a slight extent even in the presence of a powerful antiseptic, and is presumably then not a biochemical phenomenon.

(b) The traumatised piece of tissue removed immediately was examined at once by scrapings, and showed only fine oil droplets and fat cells. There were no crystals. Placed in 10 per cent. formol and kept at room temperature 30 days it showed fairly numerous fat crystals in the smears. No evidence of necrosis.

(c) Tissue removed 48 hours after traumatism showed only oil droplets in finely divided state and no crystals. No evidence of necrosis although fat seemed softer than normal. Again examined at the end of 28 days in 10 per cent. formol, a very few typical crystals were found after prolonged searching.

(d) Tissue removed in four days with exactly the same findings. At the end of 26 days fairly numerous fatty acid crystals were found in scrapings. No evidence of necrosis.

(e) Tissue removed at the end of 6 days showed in one place a brownish discoloration nearly a centimeter in diameter, evidently a spot of hemorrhage and necrosis. Scrapings made at once from the normal appearing fat showed no crystals, but at the end of 24 days fairly numerous fatty acid crystals were found in the same tissue. The stained sections will be described later.

(f) Tissue removed 8 days after the traumatism. No evidence of necrosis. Fatty acid crystals were not found at once, but were very numerous in the scrapings at the end of 22 days.

(g) Tissue removed at the end of 14 days. Gross appearance not markedly different from the others. Scrapings taken immediately showed no fatty acid crystals. No evidence of necrosis. At the end of 16 days numerous crystals were found.

(h) A piece of tissue including the suture line of one of the first incisions was removed at the same time as specimen (g). Necrosis was present around the sutures (which were of horse-hair and had been in place about two weeks). No evidence of infection. Scrapings from about the suture marks showed numerous typical fatty acid crystals.

It should be observed in explanation of the somewhat irregular and inconstant findings above, that the writer was quite inexperienced in laboratory technic, and that the traumatism inflicted was of a very mild and inconstant nature. The rubber guarded jaws tended to slip easily on the somewhat greasy surface of the pig's skin and the amount of pressure exerted was not severe and was quite irregular. Moreover, although the traumatised places were marked with carbol fuchsin, the stain faded fairly soon, and not improbably the places really traumatised were not excised at times.

*Experiment IV.*—With the pig under deep ether anæsthesia, a piece of skin and subcutaneous tissue was squeezed firmly with the guarded pincers for about five minutes, and carefully marked. At the end of 26 days this piece was excised and a small but distinctly indurated mass could be felt in the centre. On section, a thin-walled cyst was seen, the size of a grain of wheat, and, closely adjacent, a slightly larger area of typical fat necrosis, dull grayish-white in appearance, opaque and somewhat firmer than the surrounding fatty tissue. Scrapings showed numerous fatty acid crystals.

Frozen sections were made from the tissue (e) Experiment III, and from the specimen removed in (d), and stained in various ways, hæmatoxylin and eosin, Nile blue, Benda's stain, Sudan III, etc., and showed typical fat necrosis in each. The section from (e) was of course at a much earlier stage

## ISCHÆMIC FAT NECROSIS

and showed considerable interstitial hemorrhage: innumerable fatty acid crystals appeared in the necrosed cells and only a moderate tissue reaction (6 days duration), with no typical giant cells.

The section from Experiment IV, after 26 days, showed a thin-walled recent cyst, lined with connective tissue only, and close by an area of marked tissue reaction, new formed fibrous tissue, very numerous giant cells of the irritation or foreign body type, and considerable round cell infiltration. Fat in all stages of cellular necrosis was beautifully shown by the various stains. Innumerable crystals of fatty acid were everywhere present in this area, usually

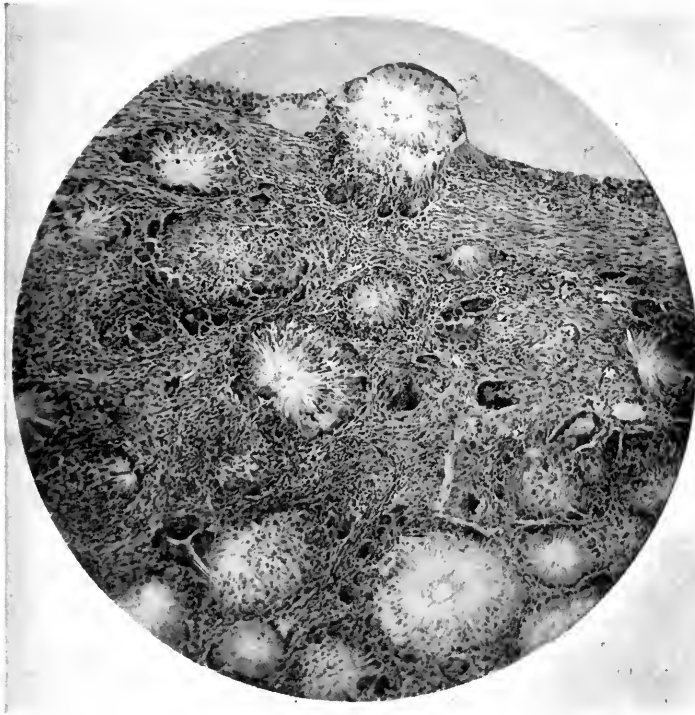


FIG. 2.—Fat necrosis, pig.

in the fat cells. There were other amorphous areas, rather deeply stained with hæmatoxylin, which were apparently calcium soaps of the fatty acids. No calcification proper was seen. (Fig. 2.)

A number of the various specimens removed were blocked in paraffin and sectioned and stained in various ways, but with the exception of the two places mentioned above, only doubtful evidence of true fat necrosis was seen.

It is only just to the pig to state that he remained perfectly well throughout the experience, all his small wounds healed by primary union, and he doubled in weight in the seven weeks he was under observation.

It may be concluded from the above that fat necrosis is rather easily produced by simple trauma, and that fat necrosis and fat splitting are two quite different processes, frequently allied, to be sure, but not necessarily so. Necrosis is the principal event, fat splitting being only an accompaniment and

probably readily occurring independently in the living or dead fat cell. Certainly in the case reported and in the experimental work one can safely exclude any pancreatic disease, or any infectious process in the fat. This leaves two possible theories of causation, (1) enzyme action from liberated blood or from the fat cell itself, (2) simple pressure necrosis from anemia with secondary fat splitting. Probably both factors take part in the process, but it is not necessary to postulate enzyme action at all for its production.

An attempt was made to determine the activity of enzyme reaction in the presence of such a strong antiseptic and germicide as formalin in 10 per cent. solution. Ethyl butyrate was chosen as the agent and glycerole extract of pancreas for the enzyme. Experiments were conducted as follows:

- A. 1. Ten c.c.  $H_2O$  plus 1 c.c. E. B. plus two drops litmus plus NaOH n/100 qs. ad alkalinity (2/10 c.c.).
  2. Ten c.c.  $H_2O$  plus 2 drops litmus plus NaOH n/100 qs. alkalinity plus pancreas extract, drops 3.
  3. Ten c.c. formol (10 per cent.) plus c.c. E. B. plus litmus plus 3 drops pancreas extract plus NaOH n/100 qs.
  4. Ten c.c. formol (10 per cent.) plus 1 c.c. E. B., litmus, plus NaOH n/100 qs.
- These four solutions were placed in a thermostat at 37 degrees C. and observed at various periods for 24 hours.

All remained alkaline in reaction except No. 2, which showed a strong acid reaction at the end of 21 hours. This experiment was repeated three times to insure accuracy, the results being identical at each trial.

- B. Using saliva and soluble starch for the reagents, the following experiments were conducted:—
1. Saliva plus  $H_2O$  plus starch.
2. Saliva plus formol (20 per cent.) in equal volume plus starch. These were incubated at 37 degrees C. In (1) at the end of 45 minutes there was a slight reduction to Fehlings. In 20 hours there was a heavy reduction to Fehlings, a nearly complete reduction, with slight formation on erythro- and achroödextrin.

In (2) at the end of 45 minutes, there were slight reduction to Fehlings and considerable erythro- and achroödextrin but no glucosazone. It was then found that formol itself would reduce Fehlings and the tests were therefore repeated, using formol and starch, and formol, starch and saliva respectively. Benedict's test for sugar was negative in each, at the end of 20 hours.

Similar tests were conducted with milk, pancreas extract and formol (10 per cent.); with ethyl butyrate, pancreas and formol, etc., and the results were identical in each test—namely, that formol in 10 per cent. solution inhibits the action of the fat splitting enzyme of the pancreas, and the ptyalin of the saliva.

From these experiments it seems fair to conclude that the fat splitting repeatedly observed to occur in the presence of 10 per cent. formol solution is not due to enzyme action, but to the fact, that fat is very unstable and easily breaks down into its constituent fatty acids and glycerole. The weak point in the argument, of course, is that the surface film of oil on the specimens would prevent the full action of the formol on the tissue enzymes. As, however, the pieces of tissue used were very small and as the surface scraping in each instance showed fatty acid crystals, this objection is not a very strong one.

The ultimate fate of these foci of necrosis is of considerable interest.

Korte, at a cholecystotomy found a widespread intra-abdominal fat necrosis, while at a subsequent laparotomy for common duct stones, a year later, no trace of it was to be seen. On the other hand, Lubarsh and Ostertag found that such foci usually calcified just as the fatty acids in old tuberculous foci, in cysts, etc., calcified. In this connection a recent observation of Webber is of interest: A seven year old girl presented multiple calcified foci in the subcutaneous fat of the trunk and extremities. New ones had formed during the past year. The von Pirquet and Wassermann tests were negative and microscopical examination of an excised fragment showed only calcareous material with no tuberculous nor luetic involvement. Although Webber does not establish a certain diagnosis, this would appear to be a case of multiple subcutaneous fat necrosis of unknown origin.

CASE II.—E. C., French maid, twenty-five years of age, admitted to the New York Hospital, out-patient department, Cornell division, September 27, 1913, complaining of a painful swelling in the right thigh. Her family history was negative, and the only previous illness was a severe fever of 11 days duration, a year previously in a French hospital. At that time she received hypodermics of camphorated oil, 2 in the right thigh, 1 in the left. She has had pain in the right thigh ever since, especially on becoming tired and has noticed a small swelling at the site of the hypodermic injection.

*Examination* revealed nothing abnormal except an indurated swelling 5 cm. in diameter and 1 cm. in depth in the middle of the antero-external surface of the right thigh, attached to the skin, but freely movable on the fascia lata. The swelling is flat, tender, not discolored, and shows no signs of inflammation. On being rolled between the fingers and thumb, it presents a typical pig-skin appearance with coarse follicles. As the condition was evidently causing no great discomfort expectant treatment was advised. Nothing has been heard from her since. The case is evidently one of subcutaneous fat necrosis by irritant chemical action. The result will probably be a cyst or calcareous deposits.

CASE III.—J. J. B., male, thirty-nine years of age, chief complaint, a painful rapidly growing swelling in the left thigh. Family history negative, previous history negative except that he has been a heavy drinker and has had "attacks of rheumatism." Present history: Thirty-five years ago, at the age of four, patient was struck by a street car, receiving a severe contusion on the left thigh. He was treated by the family physician and recovered promptly. There was no fracture. Ever since this injury, he has had a hard, painless flat swelling over the antero-external surface of the left thigh, near its middle. This caused no inconvenience nor symptoms until two months ago, when the lump was contused by falling lumber. Since then the swelling has increased in size and become very tender.

Examination revealed a vigorous, healthy working man with a swelling on the antero-external surface of the left thigh about its middle, attached to the skin, and to the fascia lata. The swelling was not discolored, but was slightly tender on manipulation. It was about 10 cm. in diameter and raised 1 cm. above the surrounding skin. It was extremely hard, evidently calcareous, except at its centre, which presented an area of fluctuation about 3 cm. in diameter. The diagnosis was in doubt as malignancy could not be excluded, but the opinion was expressed that the condition was a calcareous degeneration of a subcutaneous lipoma.

Under ether anæsthesia, April 14, 1914, the tumor was completely excised, including a large area of skin, fat, and fascia lata, which was markedly involved. The wound healed per primam and the patient has been perfectly well since. Examination of the specimen showed multiple, thick-walled cysts surrounded by dense fibrous tissue and large calcareous deposits. (Fig. 3.) The content of the cyst was a peculiar opaque, white liquid, very thick, and strikingly like white lead in appearance. In places this was replaced by semi-solid material, like caseating tuberculosis, but distinctly different in color. Microscopical examination of the cyst walls showed only old fibrous tissue and calcareous deposits. No epithelial lining could be observed. Smears made from the semi-solid areas

showed innumerable cholesterol crystals and other amorphous substances, evidently calcium soaps. On treating this substance with strong sulphuric acid, followed by iodine, the cholesterol took on its characteristic purple stain, while the soaps were broken up and fatty acid crystals in great abundance were precipitated.



FIG. 3.—Case II. Fat necrosis, adult.

This case is undoubtedly one of subcutaneous fat necrosis by trauma, resulting in cyst formation and calcareous degeneration. There were no evidences of syphilis, tuberculosis, nor malignant disease.

The three cases described, present three stages in the same disease. All occurred in young subjects with abundance of subcutaneous fat. The infant showed necrosis of tissue with fat splitting and the early stage of tissue reaction, innumerable giant cells and beginning fibrous tissue replacement. The conditions present in the young girl, a year after the chemical trauma, are only conjectural, but probably would show large deposits of calcium soaps and marked new formation of fibrous tissue. Case III shows the end result of subcutaneous fat necrosis, with cyst formation, calcareous deposits and masses of cholesterol and calcium soaps.

CASE IV.—F. G., fifty-three years of age, farmer, operated upon in the service of Dr. Alfred Taylor at Fordham Hospital for a large paraumbilical hernia of many years' duration. The family and past history were negative and the hernia was reducible until recently. There had been no injury, or history of abdominal disease. The patient was very obese but otherwise in robust health. At operation, a moderately large omental hernia was found and in the protruding portion just at and outside the ring, were three small calcareous nodules embedded in the fat tissue. The largest was  $1 \frac{5}{10}$  cm. in greatest diameter. These three nodules were removed and examined with the following results:—Calcium was present in considerable quantity. Carbonates in small quantity. There were also fatty acid crystals, oil droplets, and amorphous bodies, probably soaps. Quantitative analysis by the sulphuric acid—ether extraction showed nearly 30 per cent. of the calculi to consist of fatty acid while soaps were present in considerable amount.



There can be no doubt that this is a case of fat necrosis, but the origin of it is not absolutely clear. In all probability the frequently repeated trauma of passage through the ring and pressure of external objects during heavy labor caused the necrosis, but partial strangulation at the ring cannot be excluded. Pancreatic disease is of course a possibility but not probable. Calcareous degeneration of appendices epiploicæ is not very uncommon, presumably following a fat necrosis of mild degree but not of traumatic origin.

CASE V.—Female, about thirty years of age, admitted to the service of Dr. I. S. Haynes, in the Harlem Hospital, and examined by me through his courtesy. There was a history of severe trauma to the right thigh, about 6 weeks previously, followed by a slightly painful swelling in the subcutaneous fat, just above the knee. This swelling was of a peculiar sausage shape, was somewhat tender, attached to the skin, but not to the fascia lata. It was partly excised by Doctor Haynes and pronounced a sarcoma by a competent pathologist. But further examination proved it to be merely an extensive area of fat necrosis with typical giant cells, fat crystals etc. Reproduction of fatty and fibrous tissue was quite pronounced.

CASE VI.—O. E., female, thirty-eight years of age, entered the Cornell or First Surgical Division of the New York Hospital, March 3, 1917, complaining of a painful series of subcutaneous tumors in the right deltoid region. The only history we could obtain, was that following a miscarriage three years ago, in Greece, a midwife gave her a hypodermic injection of some medication, possibly quinine. There was no immediate reaction except slight induration but later marked induration and pain followed. Examination showed a well nourished woman with no abnormalities, except two or three small, hard, subcutaneous nodules about one centimeter in diameter in the subcutaneous fat over the insertion of the right deltoid muscle. They were not adherent to the muscular aponeurosis but were tender. Manipulation of them seemed to cause considerable pain, radiating to the fingers, two of which were slightly swollen. These masses were excised under anæsthesia and examination proved them to consist of many large and small cysts, containing clear oily fluid in fine droplets. Scrapings showed small numbers of fatty acid crystals, but there was no acid reaction.

This case is of doubtful nature and possibly should not be classed as fat necrosis. It may be that we have here an example of encysted oil collections from injections of camphorated oil or liquid petrolatum.

CASE VII.—D. G., female, about thirty-five years of age, entered the Cornell division of the New York Hospital, in November, 1919, complaining of a small subcutaneous tumor on the posterior surface of the right arm about two inches above the elbow. She gave a history of a rather severe blow in that region five years previously, followed by considerable discoloration. A lump formed which has persisted ever since. Examination showed a stout, healthy, young woman, with a hard, probably calcareous nodule in the subcutaneous fat over the right triceps. It was only slightly tender, and scarcely if at all attached to the skin. This mass was excised by Dr. Kenneth Johnson of the Staff and healing was uneventful. Examination showed an encysted tumor mass almost completely calcified and containing some grayish-white material, similar to that observed in other cysts of this nature. Degeneration was so complete that the microscopic examination was very unsatisfactory. A completely calcified simple epidermoid cyst could not be excluded. Another confusing factor was the presence of two apparently similar but smaller calcareous nodules in the neck which would ordinarily have been classified as calcified cervical lymph-nodes, probably tuberculous in origin.

About a dozen other similar cases have been observed during the past seven years. All were recent in origin, due to fairly severe trauma and occurred in young, robust, and stout subjects. The tumor masses lasted for periods up to three months and then gradually disappeared or the patients no longer returned for observation. As these masses were causing no active symptoms, operative intervention was deemed unnecessary. There is little doubt, however, that in most of them we were dealing with traumatic subcutaneous fat necrosis of mild degree.

Such cases must be of fairly common occurrence and since the calcareous cysts described above are quite uncommon it must be that the great majority of them undergo spontaneous resolution and complete healing.

Subcutaneous fat necrosis is of little importance in itself, as its end results are either complete resolution or the formation of fibrous walled and calcareous cysts. The chief interest attached to the masses is that of differential diagnosis. The recognition of the possibility of fat necrosis in subcutaneous tissue is important and should be borne in mind along with the lipomata, neuromata and the granulomata. They will only rarely require surgical attention. The relation of traumatic fat necrosis to pancreatic fat necrosis may prove of considerable importance and is worthy of investigation. Its relation to cyst formation and possibly to true tumors should also be kept in mind.

Fat necrosis is therefore probably far more common than is suspected, in the brawny contusions of obese subjects, in broken-down lipomata, etc., and especially in operative wounds. Here it unquestionably must be a large factor in causing induration and probably also infection, as the presence of a foreign body, wherever found, favors the development of infection.

A number of cases of ischæmic fat necrosis, or better necro-biosis, have been shown. It has been proved comparatively easy to reproduce the condition in animals. No pancreatic disease or injury is necessary for the process of fat necrosis. Possibly no ferment action is concerned, the etiological factor being simply ischæmia. It is difficult to understand why fat necrosis in adipose children and in new-born infants is not extremely common. There probably is some other underlying factor which has been overlooked.

#### BIBLIOGRAPHY

- Adami: Principles of Pathology, vol. i, pp. 859 and 898, 1908.  
 Allbütt: System of Med., 1908, vol. iv. Part I. p. 48, also p. 299.  
 Aschoff: Path. Anat., 1911, vol. i, p. 375.  
 Benda: Münch. med. Wochn., 1895, vol. xlii, p. 107. Also 1900, vol. xlvii, p. 1575.  
 Balser: Vir. Arch., Bd. 90, 1882, p. 520. Also Verhand. d. XI Cong. f. inner Med., S. 450.  
 Berner, O.: Virch. Arch., 1908, vol. xciii, p. 510.  
 Chiari: Zeitschif f. Heilkunde, 1896, vol. xviii.  
 Chiari: Wien. Med. Woch., 1876, S. 292. Also Prager med. Wchn., 1883, p. 299.  
 Cleland, J. B., and Darnell-Smith, G. P.: 2d Report of Gov. Bureau of Microbiology, New South Wales, Fat Dissociation in Cattle and Sheep.  
 Connstein: Ergib. Phys., 1904, vol. iii, p. 200.  
 Dakin, H. D.: Monographs on Biochemistry, 1912, p. 22.  
 Dettmer: Diss. Göttingen, 1895.  
 Dubreuil: Cont. Rend. Soc. d. Biol. Paris, 1911, vol. lxx, p. 48.

- Delafield and Prudden: Text-book of Path., 8th ed., p. 655.  
 Eisenberg: Vir. Arch. f. Path. Anat., 1910, vol. cix, p. 502.  
 Engel: Monat. f. Kinderh., 1909-10, vol. viii, p. 618.  
 Frugoni and Stradiotti: Berlin klin. Wchn., 1910, vol. xlvii, p. 386.  
 Flexner: Jr. of Exp. Med., 1906, vol. viii, p. 167.  
 Fitz: N. Y. Path. Soc., 1889.  
 Furstenburg: Virch. Geschwülste.  
 Fessler: Münch. med. Wochn., 1885, No. 52, p. 791.  
 Heiduscha, Alfred: Beitrag zur chemie und analy. der Fett, Münch., 1910.  
 Hepburn: Jr. Franklin Inst. Phil., 1909, vol. clxviii, pp. 365-421, 1910, vol. clxix, p. 23.  
 Heyde: Deut. Zeit. f. Chir., 1911, vol. cix, p. 500.  
 Hammarsten and Mandel: 6th Ed. Text Book of Phy. Chem., 1911, p. 533.  
 Hanriot: 1896. Cont. Rend. de l'Acad. de Sci., vol. cxxiii, p. 753.  
 Hildebrand: Arch. f. Klin. Chir. Bd., lvii, p. 438.  
 Von Hansemann: Berlin klin. Woch., 1898, S. 1115.  
 Haffner: Münch. med. Woch., 1904, vol. li, p. 1473.  
 Jung: Beit. z. Pathogen. der acuten Pankreatitis, Diss. Göttingen, 1895.  
 Jaeckle: Zeit. Phys. Ch., 1902, vol. xxxvi, p. 53.  
 Körte: Berliner Klin., 1896, No. 102, p. 2.  
 Katz and Winkler: Die multiple Fett ge-websnekrose. Berlin, 1899. Also Münch med. Woch., 1900, vol. xlvii, p. 1085.  
 Küttner, H.: Berlin klin. Wchn., 1913, p. 9.  
 Lubarseh and Ostertag: Ergeb. der All. Path., 1896, Verkalkung, p. 642.  
 Leathes, J. B.: Monogr. on Biochem., 1910, p. 9.  
 Ludy: Arch. Exp. Path., 1889, Bd., 25, p. 347, also Handb. d. Bioch., Bd. I, S. 533.  
 Langerhans: V. Archiv., 1890, Bd. 122, p. 252.  
 Leyberg, J.: Medycyna i Kron. Ck. Warszawa, 1910, vol. xlv, pp. 816, 844, 868.  
 Leyberg, Przgl: Ck. Krakow., 1911, vol. I, p. 341.  
 Lanz: Centralbl. f. Chir., 1898, S. 1253.  
 Marx: V. Archiv., 1901, vol. clxv, p. 290.  
 Orth: Spec. Path. Anatomie.  
 Ostermaier: Münch. med. Wochn., 1901, vol. xlviii, p. 541.  
 Opie: Amer. Jr. Med. Sci., Jan., 1901, p. 27. Jr. Exp. Med., vol. xi, 1909, p. 561.  
 Perls-Neelson: Lehrb. der alge. Path., 3rd ed., 1894, p. 187.  
 Pays and Martina: Deut. Zeit. f. Chir., 1906, vol. lxxxiii, p. 189.  
 Pfeiffer: Deut. Archif. f. klin. Med., 1892, Bd. 50, S. 438.  
 Ponfick: Virch. Arch., Bd., 56, S. 541.  
 Rippert: Allgemeine Path. and Path. Histology.  
 Rothman: Virch. Archiv, 1894, 136, S. 159.  
 Schmaus: Grundriss d. Path. Anat., 1901, p. 510.  
 Smith: J. L. f. Path. and Pact. Cambridge, 1910, 11, vol. xv, p. 53.  
 Schmidt: Münch. med. Wochn., 1900, vol. xlvii, p. 640.  
 Saxl: P. Bioch. Zeit., 1908, vol. xii, p. 343.  
 Selberg: Deut. med. Wochn., 1904, vol. xxx, p. 1361.  
 Targett: Lancet., 1896, vol. i, p. 623.  
 Truhart: Wien. med. Wchn., 1905, vol. li, p. 2097.  
 Virchow: Krankhaften Geschwülste, Bd. I., S. 393.  
 Warthin: Phila. Med. Jr., Nov. 19, 1898.  
 Wells: Jr. Med. Research, 1903, vol. ix, p. 70.  
 Weber, F. P.: Brit. Jr. of Children's Diseases, March, 1913.  
 Williams and Stockton: Am. Jr. Med. Sci., 1895, vol. cx, p. 251.  
 Wiesinger: Münch. med. Wochn., 1900, vol. xlvii, p. 1757.  
 Wulf: Berl. klin. Wochn., 1902, vol. xxxiv, p. 734.

## THE SIGNIFICANCE OF DIARRHŒA FOLLOWING ABDOMINAL OPERATIONS \*

By EDWIN BEER, M.D.

OF NEW YORK, N. Y.

THERE are very few more startling and dramatic experiences in the after-care of a surgical condition than the sudden and unheralded development of a complication that overwhelms a patient who, to all appearances, has been making an excellent recovery from a serious disease. It is most fortunate that severe diarrhœas develop very rarely during a smooth convalescence, in patients operated upon for intra- or extraperitoneal diseases of the abdominal organs, all the more so as these diarrhœas may be completely uncontrollable and lead to the death of the patient.

Consider a long-suffering patient who has been operated upon for ulcer or carcinoma of the pylorus, either a pyloroplasty with excision, or a gastro-jejunosomy, or a resection, as the case may be, being done; he comes out of the first few days nicely and rapidly recovers what seems to be a normal condition. Everything is serene, when suddenly, with or without pain, with or without a rise in temperature, in the beginning of the second week a diarrhœa sets in which may rapidly become uncontrollable. Until this complication develops, an uneventful convalescence is taking place. At first one ignores the diarrhœa, but in twenty-four hours one realizes it is a serious and threatening complication, and if uncontrolled, the patient rapidly succumbs. Or again, imagine a patient suffering from a perforated gastric ulcer with beginning general peritonitis; he is operated upon, the perforation is closed. Rapidly he comes out of shock, all his symptoms of peritonitis disappear, he is taking nourishment, and by the end of the first week convalescence is well under way. Suddenly into this quiet picture a new and mysterious development obtrudes itself in the shape of a diarrhœa. Again, at first one is not alarmed, but within twenty-four to forty-eight hours, the uncontrollable diarrhœa saps the patient's strength, and within a few days, rapid wasting sets in and the patient dies, presenting the well-recognized picture of a case of acute cholera, unless the cause of the diarrhœa is discovered and eliminated. Fortunately, as I have said, these startling complications are most exceptional. Some ten years ago I saw such a case and ever since then I have been keenly interested in this condition and have attempted to study this complication, attacking the problem from various angles in the hope that I might arrive at a better and clearer understanding of the causation and of the treatment. The results of this very incomplete study are herewith presented.

Before going any further, I wish to make it clear that I am not referring to diarrhœas that are the result of overcatharsis, or due to overuse of enemata,

---

\* Read before the New York Surgical Society, January 10, 1923.

etc., nor to those caused by the flaring up or a relapse in cases of bacillary or amœbic colitis.

The literature on this subject up to date has been very scanty, though of late more references to this complication are beginning to appear. Continental writers have given more attention to this complication than the English speaking profession. Both groups have seen diarrhœas in cases of gastric or duodenal ulcers, as well as in cases of gastric cancer following operation. Perhaps A. Carle and G. Fantino<sup>1</sup> were the first to report on this condition. Case 73 of their series was a pylorectomy with gastro-enterostomy in a cachectic patient. A fatal diarrhœa developed. Autopsy showed a gastro-enteritis which they attributed to intoxication caused by chloroform anæsthesia and dyspepsia. Kelling<sup>2</sup> calls attention to the diarrhœas, usually mild, occasionally severe, coming on in the first days after gastro-enterostomy, and believes they are due to hydrochloric acid irritation of the intestinal mucosa. He suggests that some may be due to abnormal fermentation in cases with no acid, and these are a much less dangerous type. W. Anschuetz,<sup>3</sup> having lost two cases within a year with fatal diarrhœas following gastric operations, attempted a complete study of this complication. Both of these cases had convalesced normally to the seventh and tenth days, respectively, when uncontrollable diarrhœa set in. The complication was most uncanny and startling. He refers to Terrier and Hartman, as well as Monprofit, who attribute the condition to resorption of putrefactive materials or irritation of the small gut after the relief of pyloric obstruction. W. Anschuetz saw in all, close to a dozen cases beginning between the sixth to the tenth days after operation for benign or malignant conditions of the stomach, and at least five of these were fatal. Three cases came to autopsy; they showed no peritonitis. In three cases there were ulcers in the colon and in the rectum with diphtheritic colitis or proctitis. In reviewing five hundred gastric operations, he found about thirty cases of post-operative diarrhœa, a percentage of these apparently inexplicable. Of these thirty, there were seven gastro-enterostomies for carcinoma with four deaths, and four resections or pyloroplasties with one death. In his experience, this complication occurs after typical gastro-enterostomy with short loop, with stoma too low in jejunum, and also after reëstablishment of normal continuity (Billroth I). Anschuetz is inclined to believe that too rapid emptying of stomach through the stoma and the weakened condition of the patient favor the development of the diarrhœa. Dietary errors may contribute, Anschuetz admits, as in a case reported by Stich, but usually are not the cause. He has seen it when the gastric juice was not acid, when there was no fermentation, and when the stoma was not too low in the small intestine. G. Durand<sup>4</sup> has noted early development of diarrhœa in over twelve per cent. of stenosing ulcer cases after gastro-enterostomy. He attributes it to too early return to normal diet and to purgation. It may be transient or last for months; it may be continuous or intermittent; each recurrence following errors in diet or fatigue. It may begin months after operation, and the prognosis in his cases was almost regularly favorable. He believes

that nervous influences in addition to large stoma with rapid emptying are the underlying causes. These mild cases seem to be in a different class, and perhaps pathologically quite different from those studied in this paper. A. Mathieu and R. Savignac<sup>5</sup> have seen such mild cases as just referred to as well as the severe and fatal cases. These latter they have seen in cachectic malignant disease and the complication has been acute. Too rapid emptying, they believe, has a causative relation to the development of the diarrhœa. H. Paterson<sup>6</sup> also calls attention to this condition and, referring to previous writers on this subject, says he has seen it only twice and that he thought it due to intestinal toxæmia and relievable by calomel. Moynihan<sup>7</sup> says he has seen only one case, in whom the diarrhœa lasted five days and patient recovered. He concludes from his study of the literature that "it is apparent that no adequate explanation of this complication can be given." Jonas'<sup>8</sup> study of gastrogenous diarrhœas should be mentioned here. From a study of cases of achylia, hyperacidity and extreme gastropsis, he concludes that when the pylorus is unduly permeable, there is a predisposition to diarrhœa, while with defective motor functioning of the stomach and intestines, there is unduly long pyloric closure. These observations, from a totally different angle, lend some support to the influence of a too large stoma. More recently, Troell<sup>9</sup> has reported eleven cases of this complication in ulcer patients; four after gastro-enterostomy; three after sleeve resections; three after pyloric exclusion and gastro-enterostomy, and one after segmental resection and gastro-enterostomy. Key has also seen this complication and emphasizes the fact that it may be fatal. In 1920, F. Bierende<sup>10</sup> reported seven post-operative cases with proctitis and colitis coming on from two to six days after operation. In six cases there was peritonitis, and in the seventh case there was suppurative paranephritis. Four of these patients had operations in the upper abdomen or stomach, and three had laparotomies for other conditions; all died. He believes there is a primary circulatory disturbance (vaso-paralysis) which allows of the development of the proctitis or colitis. He calls attention to the fact that Wertheim encountered this condition occasionally in his radical operations for carcinoma of the cervix. W. Goldschmidt and A. Muellender<sup>11</sup> review two hundred seventy-three stomach operations with three fatal cases due to diarrhœa. Ten cases developed this complication. The three that succumbed were evidently bad risks.

CASE I was a gastro-enterostomy for carcinoma who developed eleven days after operation bloody diarrhœa with bacillus coli and bacillus fecalis alkaligenes. Autopsy showed acute necrotic ileocolitis and general cachexia. CASE II was a subtotal resection for carcinoma. Diarrhœas began one day after operation. Bacteriological examinations were negative. Autopsy showed diphtheritic ileocolitis. CASE III was an exclusion and gastro-enterostomy. Diarrhœa began six days after operation. Autopsy showed ulcerative ileocolitis. The authors say that they have seen the same complication in fracture of the spine (two cases) and in brain tumors (three cases). The clinical picture resembles dysentery without the specific bacilli.

## DIARRHŒA FOLLOWING ABDOMINAL OPERATIONS

From this brief review of the literature, it is apparent that the cause of the diarrhœas is not clear. I believe we can dismiss those mild and usually transient cases that are mentioned by some of the authors and appear to follow too early changes to full or improper diet, overeating or purgation. The explanation based on chloroform anæsthesia can also be dismissed. Can we, however, dismiss too rapid emptying through too large or even a proper sized stoma? Originally, I thought this might be the best explanation until I encountered this complication in a case of perforated ulcer, in which the ulcer alone was repaired and no gastro-enterostomy performed. Moreover, cases have been reported in the literature following pyloroplasty and reëstablishment of normal continuity. A review of the cases already reported would suggest a variety of possible causes. It seems most likely that a terminal infection in a cachectic patient would explain many of the published cases. Perhaps a renal insufficiency may contribute to this, as it is well known that the type of colitis reported above is very similar to that seen in chronic nephritis. However, it would seem that such cases as reported by Bierende and Wertheim belong in another group. While the chance of controlling the diarrhœa in the former group may be slight, in the latter group, if one is on the lookout, it is just possible that the serious complication may be controlled.

Before analyzing the situation any further, let me briefly describe five fatal cases that have been encountered by the writer during the last ten years:

CASE I.—M. B., male, thirty-five years, June 6, 1912. Bellevue Hospital. Alcoholic. Diagnosis: Perforated duodenal ulcer and peritonitis. Operation about thirty-six hours after onset. Perforation closed. No loop posterior gastrojejunostomy; cigarette drain in upper angle of wound. Patient developed pulmonary signs suggesting consolidation. Urine contained hyaline casts. Five days after operation, while patient was apparently doing well on a very simple diet, diarrhœa set in. At first no alarm was felt, but when despite castor oil, followed by bismuth and colon irrigations, the diarrhœa became more severe and the temperature, which at first rose, became subnormal, it became clear that the patient would die unless we ascertained the cause and gave relief. We became thoroughly alarmed by this unexpected complication. After thirteen days of uncontrollable diarrhœa, the patient died. No cause was found clinically, and no autopsy allowed.

CASE II.—P. B., male, fifty-six years. April 2, 1914, to April 15, 1914. Bellevue Hospital. Diagnosis: Perforated duodenal ulcer and peritonitis. Operation about twenty-four hours after onset. Perforation closed. Pyloric exclusion with linen, posterior no loop gastrojejunostomy. Tube drainage in angle of incision. Uneventful recovery until diarrhœa set in on the eighth day with temperature. Coincident with this in right iliac fossa, tenderness and rigidity developed but no definite mass. The diarrhœa became uncontrollable. Patient rapidly collapsed and died about five days after the onset of the diarrhœa. After death the right iliac fossa was aspirated to determine the presence of a secondary abscess, and pus obtained. No autopsy allowed.

CASE III.—I. A., male, fifty years. February 7, 1915, to February 17, 1915. Mt. Sinai Hospital. Diagnosis: Perforated duodenal ulcer and peritonitis. Operation within twenty hours of onset. Perforation closed. Drain in angle of incision. Uneventful recovery until fourth day, when diarrhœa set in. Patient

rapidly wasted away with uncontrollable diarrhoea and died six days later. Here, too, the temperature gradually rose with the development of the diarrhoea. The urine showed albumen and granular casts. No secondary abdominal suppurating focus could be detected. No autopsy allowed.

CASE IV.—P. F., male, fifty-two years. February 9, 1917, to February 23, 1917. Bellevue Hospital. Diagnosis: Perforated gastric ulcer and peritonitis. Immediate operation. Suture of perforation. Uneventful recovery until fifth day when diarrhoea set in. This continued for nine days, was uncontrollable, and patient died. No autopsy allowed.

CASE V.<sup>12</sup>—C., male, forty years. September 12, 1922, to September 25, 1922. Bellevue Hospital. Diagnosis: Perforated gastric ulcer and peritonitis. Operation within seventeen hours of onset. Perforation in stomach sutured. Uneventful recovery until seventh day when temperature rose and uncontrollable diarrhoea set in. Indefinite mass developed in right iliac fossa, which was opened and pus drained. Patient developed pericarditis, became more and more emaciated and died thirteen days after operation. Autopsy not allowed.

Here we see five cases of perforated ulcers with peritonitis, in which an uncontrollable and apparently inexplicable diarrhoea developed during a satisfactory convalescence. In two, an anastomosis had been made, and in three, only a closure of the perforation. It is apparent that in these cases the explanation based on rapid emptying through the stoma is not applicable, even should it have a causative relation in some of the cases. It is most unfortunate that no autopsies were obtained. Evidence was developed after death in Case II pointing to a pericæcal exudate, and in Case V a similar condition obtained. Does such a pericolic or pericæcal suppuration throw any new light on this obscure subject?

Let us investigate this last point a little further and look at the whole subject from a different angle. It is evident from these cases that the explanation of the diarrhoeas in these cases may be quite different from that underlying many of the reported cases. In those that came to autopsy in W. Anschütz's series, no suggestion of pericolic abscess, or localized peritonitis, was made; while in the cases reported by Bierende and others, involvement of the peritoneum was a frequent occurrence. For many years I have noticed that diarrhoea may set in after an operation for acute appendicitis and it almost regularly means a localized pericolic abscess. Why some patients develop such abscesses and have no diarrhoea, is not evident. Nevertheless, the development of diarrhoea in such cases I believe most significant, and the fact that the diarrhoea ceases on drainage of the local suppurative peritonitis confirms the casual relationship.

Without making an extensive review of the available records, as I have observed this coincidence many times, I have recently looked into the records of some two hundred fifty cases of acute suppurative appendicitis with or without gangrene of the appendix, with local or general peritonitis, and I have found that diarrhoea developed in the convalescence of six cases and was in each instance relieved by drainage of an intraperitoneal abscess. The type of diarrhoea, it must be admitted, was less severe than that seen in the gastric cases referred to above, but that might be explained by the youth and the



## DIARRHŒA FOLLOWING ABDOMINAL OPERATIONS

resistance of the patients as well as by the brief period of illness of these cases. Once I saw this same complication in an interval case which is well worth mentioning briefly:

Mrs. L. K., Mt. Sinai Hospital, thirty-one years. Diagnosis: Chronic appendicitis with gastric symptoms suggesting ulcer. At operation, a rectocæcal appendix was removed and stump not inverted. The base of the appendix was well up on the posterior cæcal wall and when the loose cæcum was allowed to fall back into its position, it blocked the approach to the base of the appendix so that the omentum could not reach it and form the usual protective adhesions. At operation there was visible pylorospasm as well as antral spasm. The patient made a satisfactory convalescence, all reflex gastric symptoms being relieved until the fifth day when temperature rose to 103.8; reflex gastric symptoms, tenderness, and a mass in the right iliac fossa developed accompanied by marked diarrhœa. This condition continued for five days when suddenly, with the rupture of the retro-cæcal abscess into the cæcum, the mass, the tenderness, the temperature and the diarrhœa disappeared, as well as the reflex gastric symptoms.

Similar cases associated with diarrhœa are seen every once in a while previous to operation when the retrocæcal, chronically inflamed appendix is complicated by a localized typhlitis with thickening of the cæcal wall. Recently I saw such a case. It was difficult to decide whether we were dealing with a dysentery and appendicitis or only the latter.

Although these intraperitoneal abscesses usually follow intraperitoneal operations, rarely extraperitoneal procedures may be followed by this complication, and in the following case such an intraperitoneal suppuration produced marked diarrhœa:

L. K., nineteen years, Mt. Sinai Hospital. Diagnosis: Right pyonephrosis; nephrotomy and drainage followed by nephrectomy when condition had improved. About eight days after nephrectomy there developed a violent diarrhœa with low temperatures (maximum 100.2). The diarrhœa was almost uncontrollable with ordinary drugs, and it was only after we found an indefinite mass in Douglas' pouch extending into the left iliac fossa that we recognized the cause of this unusual complication. As the abscess in Douglas' pouch became more evident, it was incised and drained through the rectum, and the patient's diarrhœa ceased and he made a complete recovery.

It is evident from this brief account that if diarrhœa sets in after operations on the abdominal viscera, it is our duty to search for such pericolic abscesses and drain them. How often they are present and unrecognized when diarrhœa is the dominant symptom in the clinical picture, time alone, with further experience, will tell. The literature may have placed too great an emphasis on the rapid emptying through too large a stoma, ignoring such possibilities as just mentioned.

### CONCLUSIONS

1. Diarrhœa may follow any operation on the intraperitoneal or extraperitoneal abdominal organs.
2. Occasionally this diarrhœa is uncontrollable and the cause of a fatal outcome.
3. It may appear out of a clear sky during an uneventful convalescence, either early or late in this period.

4. The exact causation of the severe diarrhœa is very difficult to determine and each case should be studied individually. The milder transient diarrhœas are probably dyspeptic or irritative in origin.

5. Localized pericolic suppurative peritonitis, ileocolitis and proctitis, perhaps as a terminal infection in weakened patients, or in patients with renal insufficiency, must be considered in looking for an explanation, while it is just possible that too large a stoma may favor the development of this startling complication.

6. From a therapeutic standpoint, the mild cases seem to recover on simple diet and the usual astringent therapy; on the other hand, the severe cases have baffled all therapy, though if we may reason from analogy, one would expect to control some few of these if due to pericolonic inflammation by a drainage operation. Those in which the complication seems to be of the type of a terminal infection superimposed on a cachexia or renal insufficiency will probably continue to be rebellious to therapy.

#### BIBLIOGRAPHY

- <sup>1</sup> Arch. für klinische Chirurgie, vol. lvi, p. 217, 1898.
- <sup>2</sup> Arch. für klinische Chirurgie, vol. lxii, p. 336, 1900.
- <sup>3</sup> Mittheil, a. d. Grenzgeb., vol. xv, 1905-6.
- <sup>4</sup> Le Progrès Médical, Jan., 1913.
- <sup>5</sup> Arch. d. Malad. de l'App. Digest, p. 541, 1913.
- <sup>6</sup> Surgery of Stomach, page 83, 1913.
- <sup>7</sup> Abdominal Operations, vol. i, p. 237.
- <sup>8</sup> Med. Klinik, Berlin, Oct. 25, 1914.
- <sup>9</sup> Deut. Zeitsch. für Chir., vol. cxlix, 1919.
- <sup>10</sup> Mitth. a. d. Grenzgeb., vol. xxxii, 1920.
- <sup>11</sup> Mitth. a. d. Grenzgeb., vol. xxxii, 1920.
- <sup>12</sup> Courtesy of Doctor McMillan.

## DOUBLE KIDNEY

BY DANIEL N. EISENDRATH, M.D.  
OF CHICAGO, ILL.

CONTINUED FROM PAGE 475

*Clinical Aspects.*—There is no essential difference between the various pathological conditions which are found in double kidney and those of a single kidney.

In 80 clinical cases (Tables I to IV) which have been collected, the incidence of the different diseases for which operation was performed is about the same as one expects to find in a single kidney, namely.

Infections (uncomplicated pyonephrosis and pyelonephritis) .	24 of 62 cases
Hydronephrosis (uncomplicated) . . . . .	16 of 74 cases
Calculous disease (renal and ureteral) . . . . .	24 of 80 cases
Hydronephrosis due to ureteral stricture . . . . .	3 of 62 cases
Tuberculosis . . . . .	14 of 74 cases
Obstruction by anomalous vessels . . . . .	2 of 80 cases
Neoplasms . . . . .	3 of 80 cases

It is self-evident that there are no pathognomonic symptoms indicative of disease of one or both halves of a double kidney which would enable one to recognize the condition clinically before operation.

Of the total of 80 collected cases, including two of the writer's, a pre-operative diagnosis of double kidney was made in 32 (40 per cent.). Of these the diagnosis was made through the aid of pyelography and opaque catheters in 23, by the observation of two ureteral orifices on one or both sides of the bladder in 7 cases and finally by noting that clear and turbid urine was obtained alternately from the ureteral catheter in 2 cases.

In 58 cases (60 per cent.) the diagnosis was either made at operation or upon examining the specimen.

It is of great interest to note that of the 32 cases in which the correct pre-operative diagnosis was made, the majority were reported during the past ten years, that is, since pyelography is employed as a more or less routine procedure in the examination of a urological case. (Figs. 30, 31, 32 and 33.)

In addition to the history and symptoms pointing to some surgical affection of the kidney the specific diagnosis of the presence of such disease in a double kidney is dependent upon the following data:

1. Finding two ureteral orifices on one or both sides of the bladder (Fig. 19). Under such circumstances the diagnosis may present no difficulties unless the ureteral orifices are far apart or are very small or one does not functionate and thus escape detection. Braasch and Scholl,<sup>40</sup> in a recent

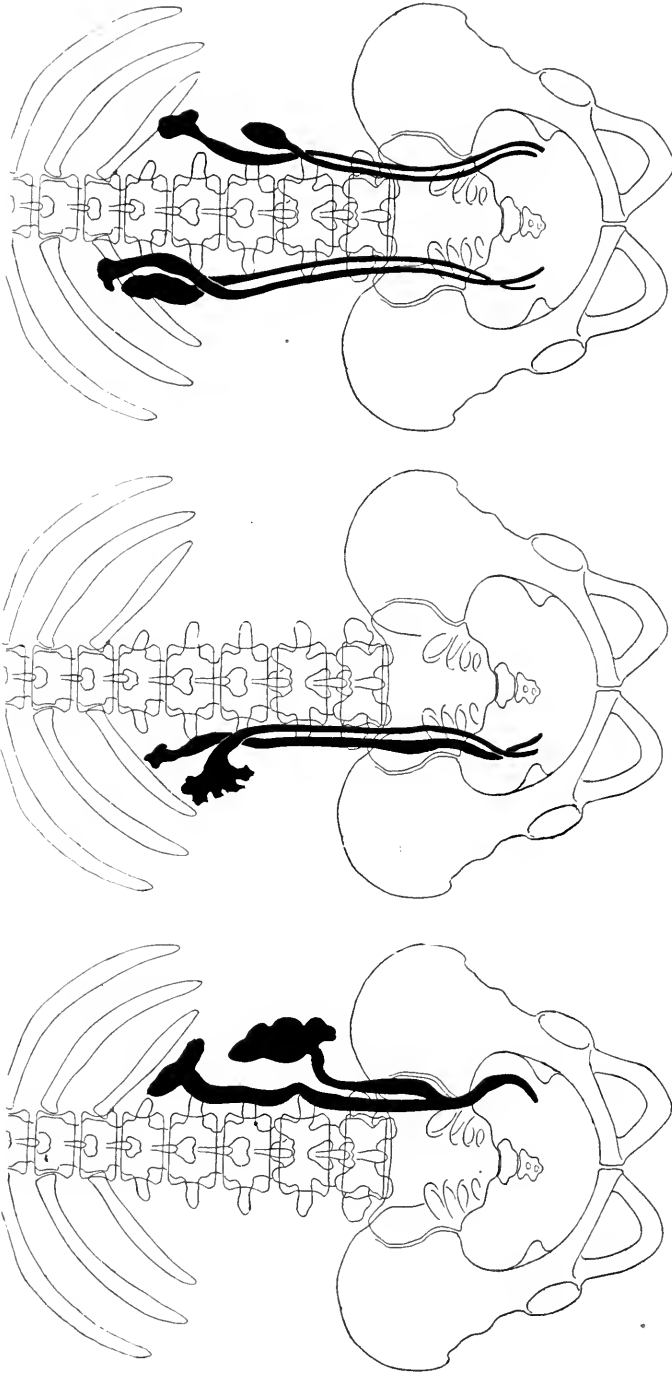


FIG. 30.—Tracing of pyelogram of unilateral incomplete reduplication of the renal pelvis and ureters. (Necker Clinic-Legneu.)

FIG. 31.—Tracing of pyelogram of complete unilateral reduplication of the renal pelvis and ureters. (Necker Clinic-Legneu.)

FIG. 32.—Tracing of pyelogram of complete bilateral reduplication of renal pelvis and ureters. (Necker Clinic-Legneu.)

## DOUBLE KIDNEY

article, speak of the difficulty of finding two ureteral orifices if retraction is present, as is so often the case in tuberculosis.

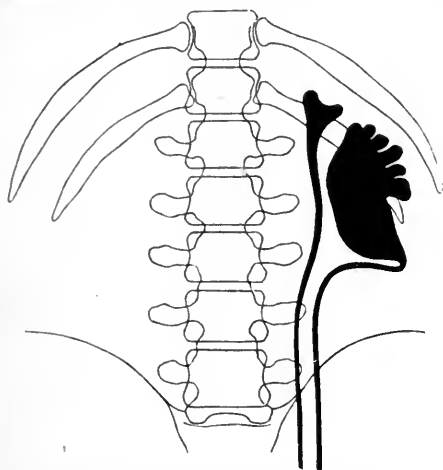


FIG. 33.—Double kidney. Tracing of pyelogram showing pyonephrosis of lower half. (Schönfeld and Friedl.)

Attention has been called under the head of morphology to: (a) the fact that a communication may exist between the ureters (Fig. 29), and (b) that the two renal pelves may communicate. This is of great importance both in relation to diagnosis and treatment.

*Treatment.*—The presence of any of the conditions enumerated above as having been found in double kidneys calls for the application of the same principles of treatment as for similar affections of a single kidney with these exceptions. Every effort should be made to preserve one-half if the other half is so involved that heminephrectomy is indicated. Such an effort to perform an heminephrectomy depends: (a) upon the blood supply to the remaining half; (b) upon the possibility of separating the diseased half and its ureter from the normal half.

(a) *Blood Supply of Double Kidney.*—The ideal condition would be to find a separate set of vessels for each half, but unfortunately this is by no means the rule.

There are three types of blood supply, namely:

2. The presence of an ectopic orifice or other form of ending of one or both ureters of a double kidney. (Figs. 18 to 28.)

3. Obtaining on ureteral catheterization alternately clear and turbid urine from one kidney. This method of diagnosis has been superseded by the more exact ones to be enumerated.

4. If only one ureteral orifice is present on each side of the bladder the diagnosis can only be made if ureteropyelography is done as a part of a thorough urologic examination.

Disease of the upper half is not more frequent than is disease of the lower. (See tables.)

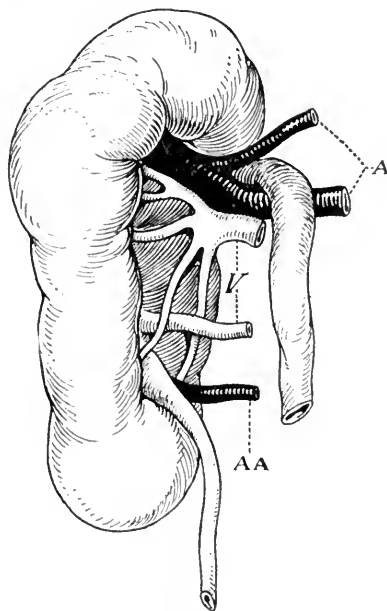


FIG. 34.—Double kidney removed on account of pyonephrosis of upper half. A single artery and vein for each half. (A and AA.) Two veins from lower half emptied into main renal vein for upper half. V. Main renal veins for upper and lower halves respectively. (Bruci.)

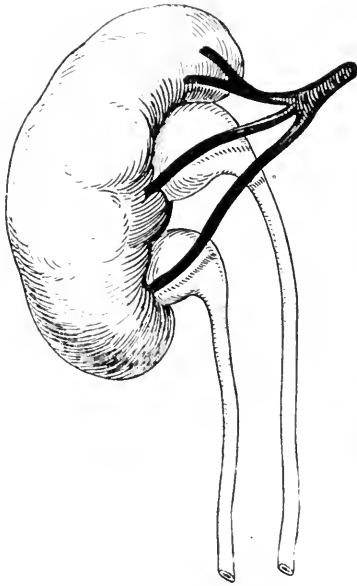


FIG. 35.—One artery for both halves of double kidney. (Duron.)

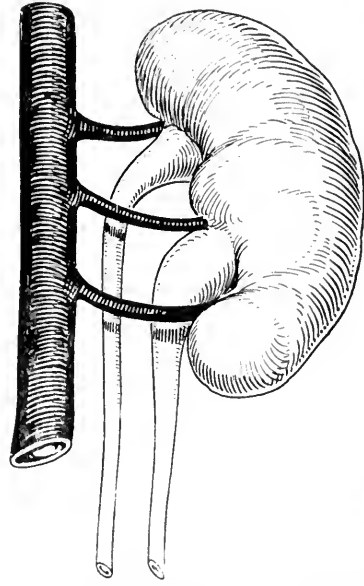


FIG. 36.—Three arteries for both halves of double kidney. (Duron.)

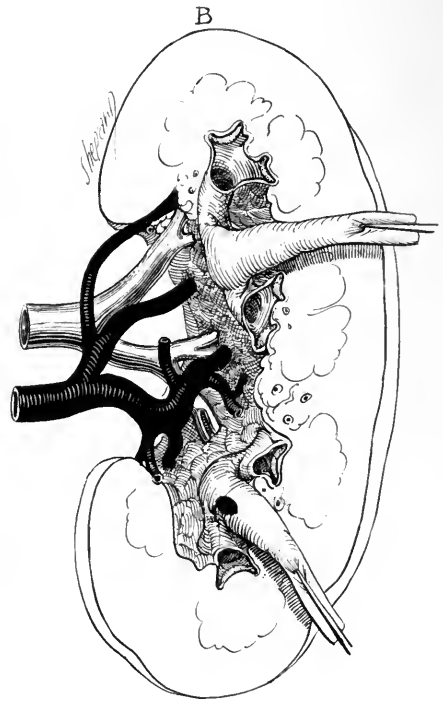
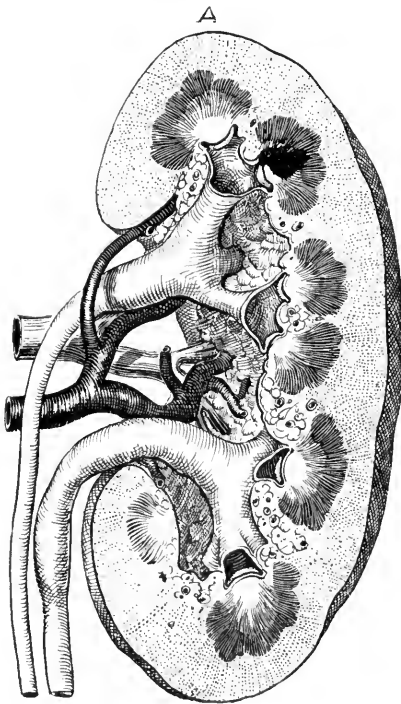


FIG. 37.—Double kidney specimen (own) showing a single artery and vein for both halves. A. With ureters *in situ*. B. With ureters retracted.

## DOUBLE KIDNEY

1. A single artery and accompanying vein for both halves. (Figs. 14, 35 and 37.)

2. Artery and vein for each half (Figs. 34, 37 and 39), one of these arteries may be an accessory vessel. (Fig. 39.)

3. Multiple arteries (3) for both halves. (Fig. 36.)

In 26 cases in which the number of vessels is mentioned, in five specimens which were personally examined through the courtesy of Professor G. Marion,

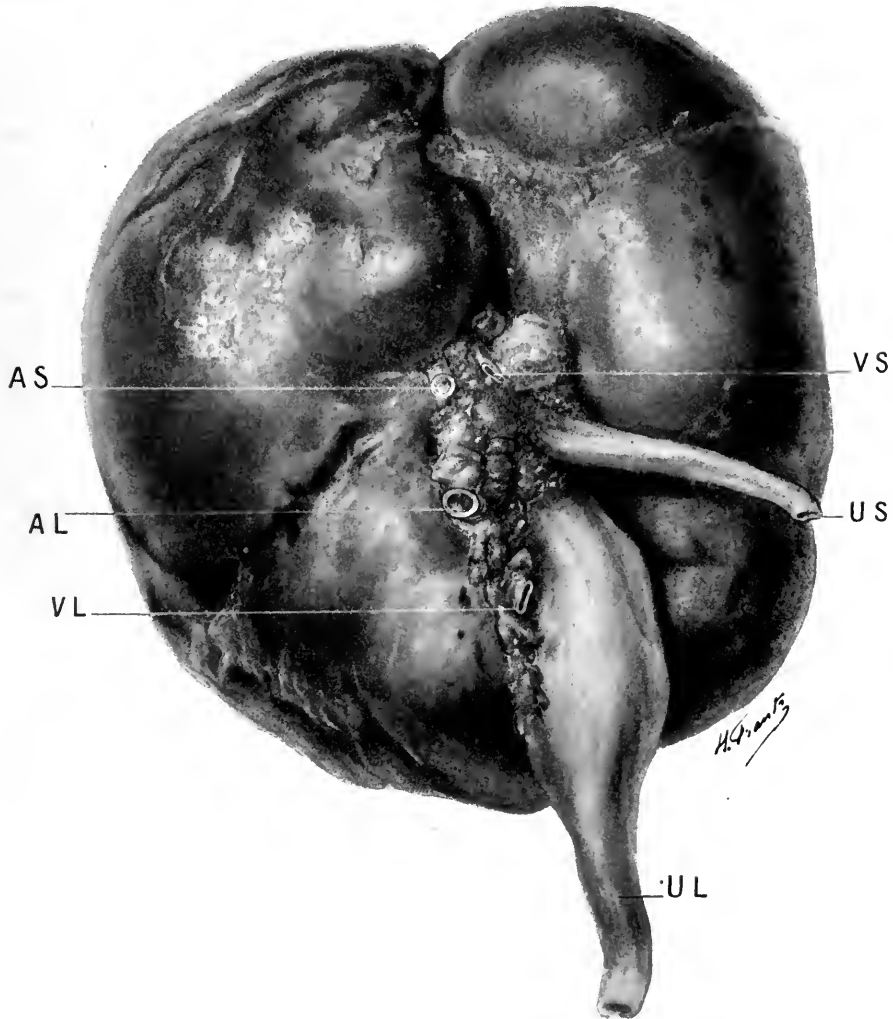


FIG. 38.—Double kidney (Marion). Note separate arteries (AS and VS) for upper and lower halves. US and UL, upper and lower ureters. Separate veins for each half (VS and VL).

of Paris, in one kidney seen at autopsy (Fig. 37) and in three cases observed at operation, a total of 35 cases, the following was found:

1. One artery for both halves—15 (43 per cent.).
2. One artery for each half—15 (43 per cent.).
3. Three arteries for both halves—5 (14 per cent.).

This means that before one decides to perform an heminephrectomy the pedicle should be exposed to determine if there is sufficient blood supply for the remaining half. This is very difficult if there are many adhesions, and no doubt many complete nephrectomies will be done in the future as in the

past, unless a clear exposure of the blood supply is feasible.

(b) The next question concerns itself with the separation of the two halves. If an external indication in the shape of a groove or furrow is present (Figs. 3 and 5) the task is far simpler than where there are no external signs of demarcation (Figs. 1 and 2). The corresponding vessels having been first clamped or ligated, one incises through the zone of demarcation. The more complete the separation of the two halves the easier will be the removal of the diseased half (Fig. 40) and the less sutures will be required to cover the cut surface of the remaining half. There are certain conditions which

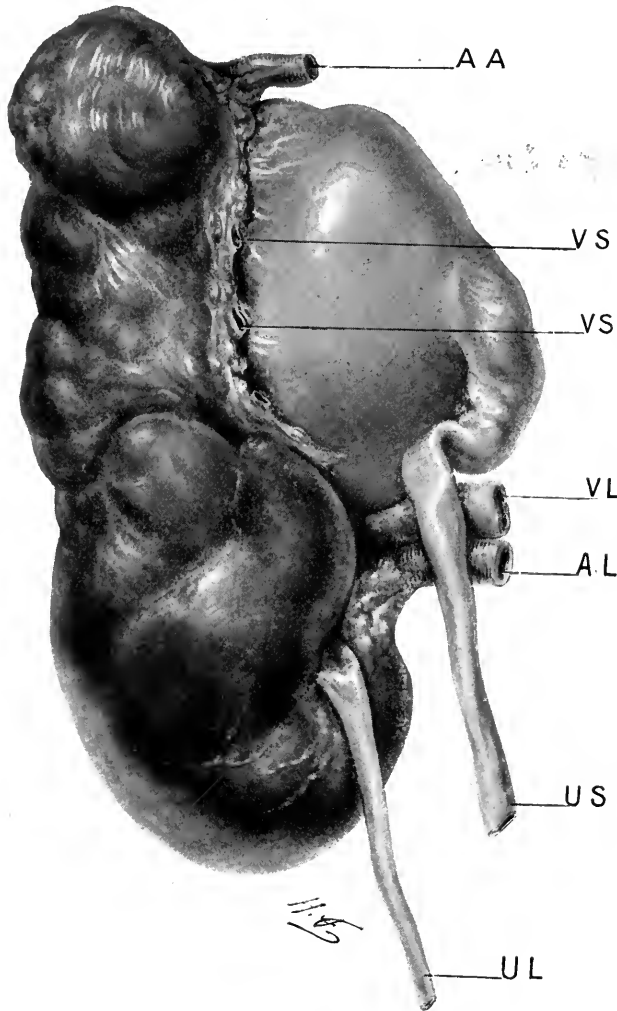


FIG. 39.—Hydronephrosis of upper half of double kidney (Krecke). AA, Accessory artery supplying upper half. VS, Two veins of upper half. VL and AL, Vein and artery of lower half. US and UL, Ureters of upper and lower halves.

serve as indication for a primary complete nephrectomy: (a) Infection, especially hæmatogenous (Fig. 1) involving both halves; (b) tuberculosis or neoplasms (malignant) unless there is complete separation of the two halves; (c) if the two pelves communicate or lie so close together that separation is impossible; (d) if the ureters lie in one sheath and cannot be separated; (e) advanced disease of both halves.



## DOUBLE KIDNEY

In the 80 collected cases (Tables I to IV) there have not been included those in which operations were performed for an ectopic ureteral ending because but few of these have been other than transplantation of the accessory or ectopic ureter.

A study of the four tables reveals some interesting facts. Both halves were described as being diseased in 21 cases of Table I. To this number must be added six in Table IV, in which a secondary removal of the remaining half was necessary. This makes a total of 27 out of 56 cases which did not permit of an heminephrectomy.

The remaining half was reported as normal in 12 of the 50 cases (Table I) in which complete primary nephrectomy had been performed, so that nearly 25 per cent. of the cases in Table I ought to have had only an heminephrectomy if the diagnosis of double kidney had been made before operation. In two of the cases such a diagnosis had been made, but for

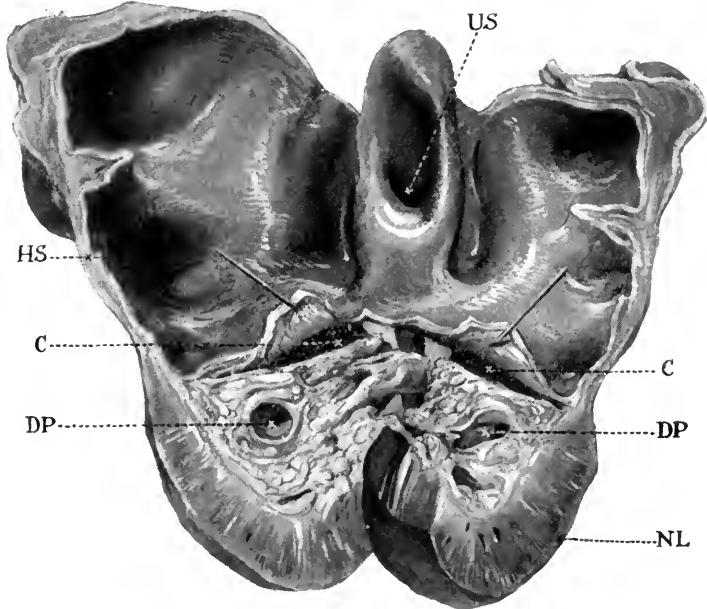


FIG. 40.—Specimen after complete nephrectomy of double kidney showing line of cleavage (C) between upper hydronephrotic and normal lower half. US. Upper ureter. HS. Sac of upper half. DP. Pelvis of lower half. NL. Parenchyma of lower half.

some reason no effort was apparently made to save the normal half. In one case (Kusnetzky<sup>41</sup>) the condition of the other half is not given.

In five cases of Table I, heminephrectomy was impossible because of technical difficulties. These are the cases of Tschudy<sup>42</sup> (No. 17)—vessels buried in adhesions, Hepburn<sup>43</sup> (No. 22)—lower normal half enveloped by the pyonephrotic upper half, my own case<sup>44</sup> (No. 32) in which the parenchyma showed no external signs of demarcation; fourth, the case of Braasch and Scholl<sup>45</sup> (No. 38)—the normal upper half emptied into the pelvis of the tuberculous lower half, and finally the case of Schoonover<sup>46</sup> (No. 45) in which the two ureters were enclosed in one sheath and could not be separated.

The accuracy of modern urological diagnostic methods is shown by the fact that it was possible to remove the diseased half in 12 cases (Table II).

TABLE I.  
*Operated Cases of Double Kidney.*  
 Cases in Which Complete Nephrectomy was Done, That is, Both Halves Removed at First Operation.

No.	Operator and reference	Age and sex	Pre-operative conditions	Diagnosis before operation	Conditions found at operation	End result
1	Floderus, Nord. med. Arkiv. No. 9, 1899	Female, 3½ years	Tumor and tenderness right upper quadrant <i>post scarlatina</i>	Infection of kidney	Pyonephrosis of upper half of double kidney, lower half normal. Complete nephrectomy that is of both halves.	Died 4 months after operation of sepsis.
2	Bruci, Ann. mal. g. u., June, 1911, 29, 961	Female, 22	Symptoms of pyelitis for four years. Single right ureteral orifice was swollen and red	Infection of kidney	Pyonephrosis upper half of double kidney. Lower half normal. Ureters joined juxta- vesically. Complete nephrectomy (both halves)	Not given.
3	Kusnetzky, Zeit. Urol. 3, 927, 1909	Female, 35	Symptoms right kidney infection. Single right ureteral orifice. Cal- culus shadow in right pelvic ureter	Calculus obstruction of right infected kidney	Pyonephrosis of lower half of double kidney, with calculus obstruc- tion of ureter of this lower half. Ureters united in bladder wall. Complete nephrectomy	Two attacks anuria and left sided colics. X-ray showed shad- ows of two calculi in left ureter. These were expelled spon- taneously during attack of anuria.
4	Linck, D. Z. Chir. 75, 51, 1904	Female, 8	Enlarged kidney and pyuria (right)	Pyonephrosis of upper half of double kidney	Complete nephrectomy	Not given.
5	Rafin, Ann. mal. g. u., 27, 184, 1909	Female, 30	Tumor left kidney. Normal ureteral ori- fices	Not given	Hydronephrosis of lower half of double kidney. Upper half normal. Ureter only double at upper end. Complete nephrectomy	Not given.

# DOUBLE KIDNEY

6	Stark, Zeit. Urol., 5, 467, 1911	Male, 16	Renal infection (left). Single gaping ureteral orifice	Infection of half double kidney made because obtained alternately clear and turbid urine per ureteral catheter	Pyonephrosis lower half double kidney. Upper half normal. Complete nephrectomy	Recovery.
7	Kroiss reported by Schoenfeld and Friedl Fort. a. d. Geb. Roent. 23, 169, 1915	Not given	Symptoms of bladder and kidney infection	Diagnosis of double kidney by pyelography	Pyonephrotic lower half due to kinked ureter. Complete nephrectomy. <i>One set of vessels</i> for both halves from which small vessels to lower half	Not given.
8	Dobrotworsky, Zeit. Urol. 7, 93, 1913	Not given	Marked bullous oedema of single ureteral orifice (right). No changes in single left ureteral orifice	Tuberculosis of kidney	After removal of kidney found only one half tuberculous. There was no demarcation between the two halves	Not given.
9	Adler reported by Ascher, Inaug. Diss. Berlin, 1908	Male, 29	Not given	Diagnosis of left hydronephrosis	Complete nephrectomy. Examination of specimen revealed large hydronephrotic lower half upon which cap-like, slightly hydronephrotic upper half rested	Not given.
10	Pawloff, Deut. Zeit. Chir. 121, 425, 1913	Not given	Tumor in right upper quadrant and persistent pain in lower abdomen increased by urination. Two normal ureteral orifices upon pre-operation examination. Small amount of pus from right ureter	Pyonephrosis (right)	Complete nephrectomy. Examination of specimen revealed pyonephrosis with calculus of lower half of double kidney. Ureter of this half obliterated close to kidney. Post-operative anuria due to calculus in left kidney. This calculus removed by pyelotomy	Death 4 years later of uræmia. Found that left kidney was also double and there were two ureteral orifices on each side of bladder. There was a communication in bladder wall of the bladder wall of the two ureters on each side.

TABLE I.—(Continued)  
*Operated Cases of Double Kidney.*  
 Cases in Which Complete Nephrectomy was Done, That is, Both Halves Removed at First Operation.

No.	Operator and reference	Age and sex	Pre-operative conditions	Diagnosis before operation	Conditions found at operation	End result
11	Pawloff, (Case 6) <i>Idem.</i>	Male, 36	Frequent and painful urination. Bullous edema of right ureteral orifice. Tubercle bacilli in urine	Right renal tuberculosis	Tuberculosis of upper half of double kidney. Lower half normal. Complete nephrectomy	Recovery.
12	Wossidlo, (Case 1) Zeit. Urol. 14, 197, 1920	Not given	Uterovaginal fistula following operation for ovarian cancer. Single ureteral orifices on both sides. Poor right kidney function	Diagnosis of double kidney not made before operation	Pyonephrosis of both halves of double kidney. Complete nephrectomy	Recovery.
13	Wossidlo, (Case 2) <i>Idem.</i>	Female, age not given	Recurrent left colics, hematuria and pyuria. Enlarged tender left kidney. Two left ureteral orifices found lying with a diverticulum. Turbid urine from upper half—normal urine from lower half	Diagnosis of double kidney made before operation by pyelography and X-ray catheters	No signs of division externally. Separate blood-vessels to each half and an accessory vessel to upper pole. Complete nephrectomy. Upper half pyonephrotic, lower half normal. Dense septum separated	Not given.
14	Rubritius, Deut. Med. W. Feb., 12, 1920, 46, Vercins Beitrag, p. 19	Female, 29	Recurrent left kidney pain. Two ureteral orifices on left side. B. Coli obtained from lateral orifice	Diagnosis of infected hydronephrosis of upper half of double kidney made by pyelography	Pyonephrosis of upper half of a double kidney with rudimentary lower half. Complete nephrectomy	Not given.

# DOUBLE KIDNEY

15	Pallin, Nord. Med. Arkiv. 50, 1, 1917	Male, 12	Pyuria, pain (right) and increased frequency. Tender enlargement in right upper quadrant	Pre-operative diagnosis of infected right kidney	Complete nephrectomy of double kidney whose lower half was pyone- phrotic. Ureter from lower half greatly di- lated and tortuous, pro- bably a congenital sten- osis	Not given.
16	Troell, Hygiea, 1913	Female, 64	Pus from right and clear urine from left single ureteral orifices	Infection of right kidney	Found double kidney. First removed upper pyonephrotic half and then lower half because did not feel certain enough blood supply	Not given.
17	Tschudy, Korbl. Schiv. Aertzte, 13, 400, 1902		Symptoms of renal in- fection. Alternately clear urine and thick pus from left ureteral orifice	Infection of right kidney	Found double kidney. Could not resect pyone- phrotic upper half be- cause blood-vessels were buried in adhes- ions, so performed com- plete nephrectomy. Specimen showed sten- osis of ureter to upper half	Not given.
18	Papin, J. d'Urol. Feb. 1921, 11, 155	Female, 25	Pain over right kidney. Two right and one left ureteral orifices. Left kidney normal	No pre-operative diag- nosis given.	Complete nephrectomy of double kidney. Both halves hypoplastic	Not given.
19	Key, Z. Urol. 4, 409, 1909	Female, 18	Pain over right kidney and shadow over this kidney area	Calculus right kidney	Complete nephrectomy of a double kidney, upper half of which was tuberculous and lower half hydronephrotic	Not given.
20	Merill and Lefebvre, Bull. Soc. Anat. 18, 387, 1921	Female, 35	Symptoms of renal tu- berculosis for several years	Tuberculosis of kidney	Complete nephrectomy, both halves tubercu- lous. Ureters united 11 cm. below kidney	Not given.

TABLE I.—(Continued)  
*Operated Cases of Double Kidney.*  
 Cases in Which Complete Nephrectomy was Done, That is, Both Halves Removed at First Operation.

No.	Operator and reference	Age and sex	Pre-operative conditions	Diagnosis before operation	Conditions found at operation	End result
21	Rumpel, Archiv. 81, 433, 1906	Male, 27	Recurrent left-sided abdominal pain	None given	Complete nephrectomy of dystopic double kidney, one-half of which was hydronephrotic	Not given.
22	T. N. Hepburn, Ann. Surg. 68, 294, 1918	Female, 45	Pyuria and enlarged right kidney. Two ureteral orifices on each side. Purulent urine only from upper right ureteral orifice	Diagnosis of bilateral double kidney and ureters made by pyelography	Complete nephrectomy of double kidney, upper half of which was pyonephrotic and so enveloped lower half that separation was inadvisable	Recovery.
23	Betzner, p. 103 of Kidney Surgery, Julius Springer, Berlin, 1921	Female, 42	Recurrent symptoms of cystitis and right upper quadrant pain. Tumor in same location. Single right and left ureteral orifices	Hydronephrosis	Complete nephrectomy of double kidney. Upper half showed advanced tuberculosis and lower half hydronephrotic	Recovery.
24	Paul M. Pilcher, Ann. Surg., May, 1917, 65, 534	Male, 41	Recurrent hæmaturia, increased frequency and pain over right kidney. Purulent urine from single right ureteral orifice. Large shadow in right kidney	Calculus in infected kidney	Complete nephrectomy of double kidney, both halves showed infected hydronephrosis with calculus obstructing lower half	Recovery.
25	Heil, Zeit. Urol. Chir. 9, 82, 1922	Female, 7	Pyuria, increased frequency and tubercle bacilli in right kidney urine	Renal tuberculosis	Complete nephrectomy of double kidney showing tuberculosis. One ureter had been mistaken for vessel	Not given.

# DOUBLE KIDNEY

26	A. Mueller, Zeit. Urol. Chir. July 31, 1922, 9, 141	Female, 18	Increased frequency, pain, pyuria. Two left and one right ure- teral orifices. Pyelo- graphy unsuccessful	Diagnosis of double kid- ney with absence of function of upper half	Complete nephrectomy of double kidney, both halves hydronephrotic	Recovery.
27	A. R. Stevens, Jour. Amer. Med. Assn. Dec. 28, 1912, 2298	Female, 43	Pain over right kidney and haematuria. Two right ureteral orifices from one of which blood and decreased function	Diagnosis double kidney with hypernephroma of lower half made by pyelography	Complete nephrectomy of double kidney whose lower pole was seat of hypernephroma	Recovery.
28	Lange, Ann. Surg. 34, 581, 1901	Male, 56	Haematuria, pain over left kidney, chills, fever and recurrent anuria. Only one left ureteral orifice	Renal infection	Complete nephrectomy of septic double kidney	Recovery.
29	Cecil, Calif. St. J. Med. Jan., 1915, 13, 34	Female, 48	Symptoms renal infec- tion (left). Two left and one right ureteral orifices	Diagnosis of double kid- ney made by pyelo- graphy	Complete nephrectomy of double left kidney— lower half of which was hydronephrotic	Recovery.
30	Swan, Proc. Royal Soc. Med. 14, 33, 1921	Male, 35	Symptoms left renal in- fection. Urine and bladder negative on examination	Renal infection	Complete nephrectomy of double kidney, lower half of which revealed large hydronephrosis. Ureters united near bladder	Recovery.
31	Eisendrath, Surg. Clin. Chicago, Oct. 1917, 1, 1053	Female, 47	Symptoms left renal in- fection. Single ure- teral orifice on each side. From left cath- eter very turbid urine	Left-sided pyonephrosis	A t first operation for drainage of infected hydronephrotic sac. Secondary complete nephrectomy of double kidney. Lower half was converted into large hydronephrotic sac. Ureter of upper normal half behind sac formed by lower half. Well marked separ- ation of halves	Died.

TABLE I.—(Continued)  
*Operated Cases of Double Kidney.*  
 Cases in Which Complete Nephrectomy was Done, That is, Both Halves Removed at First Operation.

No.	Operator and reference	Age and sex	Pre-operative conditions	Diagnosis before operation	Conditions found at operation	End result
32	Eisendrath, <i>Idem.</i>	Female, 25	Symptoms left renal infection. Single ureteral (left) orifice	Left renal infection	Complete nephrectomy of double kidney. Lower half seat of many abscesses (acute pyelonephritis). No separation of parenchyma	Recovery.
33	Braasch and Scholl, S. G. & O., Oct. 1922, 35, 401	Female, 9 months	Abdominal pain, fever and enlarged kidney	No pre-operative diagnosis	Complete nephrectomy of double kidney, both halves of which revealed infected hydronephrosis	Recovery.
34	Braasch & Scholl, S. G. & O., Oct. 1922, 35, 401	Female, 52	Dull pain in back, pyuria (left), increased frequency and small shadow in left kidney area. Ureter impermeable 20 cm. up	Diagnosis of left pyonephrosis	Complete nephrectomy of double kidney, both halves hydronephrotic. At junction of ureters (3 cm. down) calculus obstruction	Recovery.
35	Braasch & Scholl, <i>Idem.</i>	Female, 34	Symptoms of right renal infection. Single ureteral orifices on each side	Diagnosis of double kidney (right) with hydronephrosis of upper half, made by pyelography	Complete nephrectomy of double kidney whose upper ureter and pelvis were markedly dilated	Recovery.
36	Braasch & Scholl, <i>Idem.</i>	Female, 32	Pain in left upper quadrant. Much retention in pelvis of left kidney as shown in pyelogram	Left hydronephrosis	Complete nephrectomy of double kidney with much dilated lower pelvis	Recovery.



# DOUBLE KIDNEY

37	Braasch & Scholl, <i>Idem.</i>	Male, 37	Symptoms and usual findings of left renal tuberculosis.	Occluded left renal tuberculosis	Complete nephrectomy of both halves of tuberculous kidney. Well marked groove and band of parenchyma between two halves	Recovery.
38	Braasch & Scholl, <i>Idem.</i>	Female, 25	Pain left kidney, hæmaturia and pyuria. Several small shadows in left kidney area. Cystoscopy negative but blood from right ureter	Diagnosis of left double kidney made by pyelography	Complete nephrectomy of double kidney, lower half of which was tuberculous. Upper half normal but emptied into lower half. Deep external groove and band of parenchyma between halves	Recovery.
39	Braasch & Scholl, <i>Idem.</i>	Male, 33	Symptoms and usual findings of left renal tuberculosis	Renal tuberculosis	Complete nephrectomy of double kidney, both halves of which showed advanced tuberculosis	Recovery.
40	Braasch & Scholl, <i>Idem.</i>	Female, 50	Symptoms and usual findings of right renal tuberculosis with two right ureteral orifices, left upper of which was eroded and turbid urine escaped. Stricture of ureter of other half	Diagnosis of double kidney made by pyelography	Complete nephrectomy of double kidney. Lower half tuberculous, and upper half showed microscopically few tubercles in cortex	Recovery.
41	Braasch & Scholl, <i>Idem.</i>	Male, 35	Symptoms and usual findings of left renal tuberculosis	Left renal tuberculosis	Complete nephrectomy of double kidney, advanced tuberculosis of lower half and incipient of upper half (microscopic)	Recovery.

TABLE I.—(Continued)  
*Operated Cases of Double Kidney.*  
 Cases in Which Complete Nephrectomy was Done, That is, Both Halves Removed at First Operation.

No.	Operator and reference	Age and sex	Pre-operative conditions	Diagnosis before operation	Conditions found at operation	End result
42	Braasch & Scholl, <i>Idem.</i>	Male, 26	Symptoms renal infection of left kidney. Pyelography showed inflammatory changes in left pelvis	Chronic pyelonephritis with atrophy	Complete nephrectomy of double kidney. Upper half completely destroyed while parenchyma of lower half replaced by fat	Recovery.
43	Braasch & Scholl, <i>Idem.</i>	Female, 47	Symptoms mild left renal infection. Pyelogram showed small left pelvis	Atrophic pyelonephritis	Complete nephrectomy of double kidney whose lower half almost completely destroyed by fibrosis	Recovery.
44	Braasch & Scholl, <i>Idem.</i>	Female, 30	Symptoms left renal infection. Pyelogram showed small left pelvis	Atrophic pyelonephritis	Complete nephrectomy of double kidney. Many cortical abscesses in lower portion. Pelvis dilated and almost replaced by fat	Recovery.
45	F. S. Schoonover, J. Urol. Aug., 1922, 8, 155	Male, 28	Symptoms of right renal infection. Two right ureteral orifices, lateral dilated and turbid urine escaping from it	Diagnosis of double kidney (right) with infected hydronephrosis and atrophy of the lower segment made before operation	Complete nephroureterectomy necessary because two ureters were intimately related and enclosed in a common sheath down to a point 10 cm. above the bladder. Section of the kidney after operation showed that the two pelvises were so closely adjacent that heminephrectomy would have been very difficult	Recovery.

# DOUBLE KIDNEY

46	Buerger, S. G. & O., Feb. 1919	Male, 38	Symptoms renal infection and several shadows in renal area (left). Two left ureteral orifices. B. Coli obtained from one and B. Coli and many pus cells from the other left ureter	Diagnosis of infection of both halves of double kidney made from results of cystoscopy and ureteral catheterization	Complete removal of left half of horseshoe kidney which had two pelvis and two ureters. The upper part was seat of advanced renal infection and contained two calculi. No external demarcation	Recovery.
47	Wulff, D. M. W. 32, 1761, 1906	Not given	Alternation of pus and clear urine from left kidney	Diagnosis of double kidney made from alternation of pus and clear urine	Lower half (left) pyonephrotic. Complete nephrectomy	Not given.
48	Marion, Bull. Soc. Chir. 34, 905, 1908	Female, 41	Symptoms of right renal infection	Pyonephrosis	Hydronephrosis lower half of double kidney. Complete nephrectomy	Recovery.
49	Dumitreanu, (operator Dollinger). Deut. M. W. July 23, 1908, 34, 1333	Not given	Symptoms of right renal infection	Renal infection	After complete nephrectomy found that had removed double kidney. Upper half normal. Lower half showed infected hydronephrosis. Ureters very close	Recovery.
50	John E. Summers, Ann. Surg. Jan. 1901, 33, 39	Female, 2½ years	Tubercle bacilli in urine. Enlarged left kidney. Incontinence	Renal tuberculosis	Complete nephrectomy of double kidney. One ureter very thick, other normal	Recovery.

TABLE II.  
Cases in Which Only Primary Heminephrectomy was Done.

No.	Operator and reference	Age and sex	Pre-operative condition	Diagnosis before operation	Conditions found at operation	End result
1	Heyman, Med. Woch. Deut. Feb. 15, 1912, 38. Ver-eins Beitrage, 344	Female, 21	Symptoms and findings of left renal tuberculosis. Two left ureteral orifices, of which mesial ulcerated and lateral normal	Tuberculosis of left kidney	Removal of upper tuberculous half only (heminephrectomy). Lower half normal	Not given.
2	Steiner, Berl. Kl. Woch. 38, 411, 1901	Female, age not given	Hæmaturia, pyuria. Enlarged and painful right kidney	Renal infection	Upper half resected. Lower half sutured into wound	Recovery.
3	Rumpel, Zeit. Urol. Chir. 3, 33, 1914. (First case of heminephrectomy)	Male, 39	Left-sided colics, tender left kidney, hæmaturia, pyuria. Calculous shadows opposite fourth lumbar vertebra. Two ureteral orifices on each side. Left lateral orifice redder, swollen and no indigo carmine excreted	Diagnosis of calculus hydronephrosis of lower half of double kidney made by pyelography	Lower half of double kidney much dilated containing calculus. Resected lower half. Upper half normal	Post-operative urinary fistula.
4	Rumpel, Idem.	Male, 35	Symptoms of post-gonorrhoeal renal infection. Two ureteral orifices on each side. From left mesial, clear and from left lateral (which gaped) turbid urine escaped	Diagnosis of hydronephrosis of lower half of double kidney made by pyelography	Resection of lower hydronephrotic half of double kidney felt to be safe because could identify blood-vessel to upper half	Recovery.

# DOUBLE KIDNEY

5	Pawloff (Case 3), Deut. Zeit. Chir. 121, 425, 1913	Female, 28	Painful and enlarged right kidney. Single normal ureteral orifice both sides. Negative catheterization both sides	Pre-operative diagnosis not given	Resected lower hydro- nephrotic half of double kidney. Ureter of this half found obli- terated	Recovery.
6	Young and Davis, Jour. Urol. Feb. 1917, 1, 17	Male, 57	Recurrent pain and in- creased frequency. Shadow branching cal- culus in upper pole left kidney. Single ureteral orifices on each side	Diagnosis of double left kidney made before operation by pyelo- graphy. Upper large pelvis seen to be filled by calculus	Heminephrectomy of hy- dronephrotic upper half filled by calculus. Slight but distinct furrow be- tween halves	Recovery.
7	Legueu, Necker Clinics, Second series, p. 243. A. Maloine et Fils, Paris, 1922	Female, 17	Symptoms of cystitis. Two left and one right ureteral orifices. Tu- bercle bacilli urine from one of left and from the right ureter	Diagnosis of double kid- ney (left) of which one half tuberculous. Con- firmed by pyelography	Heminephrectomy of upper half of left tuber- culous kidney, later ne- phrectomy of right tu- berculous kidney. Double kidney had two sets of vessels	Recovery.
8	Hryntschak, Zeit. Urol. Chir. 9, 87, 1922	Male, 27	Recurrent left colics, pyuria and cystitis	Diagnosis double kidney made by pyelography	Heminephrectomy of pyonephrotic lower half double kidney	Recovery.
9	F. C. Herrick, Surg. Gyn. & Obst. 30, 560, 1916	Female, 18	Increased frequency and pain over right kidney. Two right ureteral orifices, lower of which showed bullous oedema	Diagnosis double kidney by pyelography	Heminephrectomy of lower hydronephrotic half of double kidney	Recovery.
10	A. Mueller, Zeit. Urol. Chir. July 31, 1922, 9, 141	Female, 29	Pain over right kidney increased frequency and burning. Two left and one right ure- teral orifices. Right lateral cranial no indigo carmine and only two c.c. purulent urine in one hour	Diagnosis of infected hy- dronephrosis of lower half of double kidney made by pyelography	Resected lower atro- phied, inflamed half of double kidney. Main vessels to upper half. Distinct groove be- tween halves	Recovery.

TABLE II.—(Continued)  
Cases in Which Only Primary Heminephrectomy was Done.

No.	Operator and reference	Age and sex	Pre-operative condition	Diagnosis before operation	Conditions found at operation	End result
11	Braasch & Scholl, (Mayo Clinic), S. G. & O. Oct. 1922, 35, 401	Female, 27	Severe recurrent right kidney pain. Branch- ing shadow in kidney area. Single ureteral orifices on each side	Diagnosis of double kid- ney with shadow in lower pelvis made by pyelogram	Heminephrectomy of lower half which was infected and obstructed by calculus. Well- marked groove. Each half had own vessels	Recovery.
12	Braasch & Scholl, <i>Idem.</i>	Female, 32	General discomfort right side abdomen for six years. Palpable right kidney. Two right ureteral orifices	Diagnosis double kidney with stricture of one ureter of upper half made by pyelography	Stricture just above bladder and much di- lated ureter leading to upper half. Latter and the ureter to within 2 cm. of bladder remov- ed. Lower pelvis and ureter normal	Still pain on same side one year later.

TABLE III.  
*Cases in Which Nephrotomy, Pyelotomy, etc., Were the Only Operations.*

No.	Operator and reference	Age and sex	Pre-operative condition	Diagnosis before operation	Conditions found at operation	End result
1	Klose, D. Z. Chir. 72, 613, 1904	Female, 59	Enlarged, tender and mobile kidney. Two ureteral orifices (right) both functioned	Movable double kidney diagnosed by X-ray catheters	Found double kidney abnormally mobile and did nephropexy	Recovery.
2	Lessing, Berl. Kl. W. Aug. 28, 1905, 42, 1126	Not given	Symptoms and shadow of renal calculus	Renal calculus	Double kidney with well-marked groove. Ureters united 7 cm. below kidney. Calculus in lower half removed by nephrotomy	Recovery.
3	Mirabeau, Zent. Gyn. 30, 706, 1906	Not given. Brief case presentation	Two ureteral orifices on each side	Not given	Drained tuberculous half of double kidney	Not given.
4	Seelig, Z. Urol. 5, 900, 1911	Female, 44	Symptoms of pyelitis. Two ureteral orifices on each side. Ureteral catheterization revealed infection of right upper and left lower pelves	Diagnosis of bilateral double kidney with complete separation of the ureters made by pyelography	No operation. Only pelvic lavage	Much improved.
5	Illyes, Folia Urol. 8, 636, 1913	Female, 32	Shadow of calculus in pelvis of right kidney. Two ureteral orifices, from lower purulent, and from upper, clear urine obtained	Calculus in infected right kidney	Pyelotomy for calculus in infected lower half. Only one blood-vessel to both halves	Not given.

TABLE III.—(Continued)  
Cases in Which Nephrotomy, Pyelotomy, etc., Were the Only Operations.

No.	Operator and reference	Age and sex	Pre-operative condition	Diagnosis before operation	Conditions found at operation	End result
6	Lichtenstern, Wien. M. W. Sept. 9, 1911, 61, 2431	Male, 32	Left colics, pyuria and increased frequency. Single ureteral orifices on each side. Left gaping, injected and urine contained many pus cells. One large and several small shadows at level of upper lumbar vertebra	Calculus pyonephrosis (left)	Found double kidney of which upper half was large hydronephrotic sac. Moved one large and several small calculi from upper half. Ureter of upper half ran behind lower half. Separate vessels for each half	Not given.
7	Israel (Case 7), Folia Urol. 1, 617, 1908	Not given	Not given	Calculi of left kidney	Found calculi in upper half of left half of horseshoe kidney having double pelvis and ureters	Not given.
8	A. Brunner, Beitr. 122, 136, 1921	Not given	Symptoms of renal infection. Two left and one right ureteral orifices. Turbid urine from left lateral orifice	Infection of double kidney	Complete nephrectomy of double kidney, lower half of which revealed infected hydronephrosis with abscess between this lower and a normal upper half, each half had own vessels	Recovery.
9	Illyes, Folia Urol. 8, 636, 1913	Female, 32	Shadow of calculus in right kidney pelvis. From lower of two right ureteral orifices purulent urine, while clear urine obtained from the other one	Calculus of kidney	Removal of calculus from pelvis of lower half of double kidney	Not given.



# DOUBLE KIDNEY

10	Franke, Beitr. Kl. Chir. Supplement to Vol. 64, 193, 1909	Female, age not given	Tumor and pain in right upper quadrant. Two right ureteral orifices. Normal urine from one but not from other	Diagnosis of double kidney made from presence of two ureteral orifices	Both pelves of double kidney found much dilated. One of the two ureters kinked by accessory vessel, which was ligated. Puncture of hydronephrotic sac	Recovery.
11	Young, Monatsbericht f. Urol. 1903, 8, 591	Male, 54	Left-sided colic with passage calculus two years before. Clear urine left and purulent right. Shadow large calculus in right kidney	Calculus right kidney	Removal large calculus from right kidney	Died of anuria. Ureteral catheter on left side had entered branch of bifid ureter leading to normal half of double kidney, in upper half calculus found which had not been shown in X-ray.
12	Brewer, Ann. Surg., June, 1911, 53, 82	Male, 28	Right colics, hæmaturia, tender right kidney and shadow below kidney	Renal calculus	Found hydronephrosis upper half double kidney due to calculus obstruction of ureter. Ureterotomy	Recovery.

TABLE IV.  
Cases in Which Heminephrectomy or Other Operations were Followed by Secondary Removal of the Remaining Half.

No.	Operator and reference	Age and sex	Pre-operative condition	Diagnosis before operation	Conditions found at operation	End result
1	Pizzetti, Policlinico, 28, (sez. chir.) 160, 1921	Male, 37	Symptoms and findings those of renal calculus	Renal calculus	Nephrotomy followed by recurrence and fis- tula. Complete neph- rectomy of double kid- ney	Not given.
2	Braasch & Scholl, S. G. & O. Oct. 1922, 35, 401	Female, 45	Symptoms renal infec- tion and passage small calculus. Two ure- teral orifices on each side. Upper left di- lated and turbid urine escaped. Lower left normal. Shadow left kidney area	Diagnosis by pyelo- graphy of bilateral complete reduplica- tion of two left pelvis. Shadow in left dilated pelvis	Heminephrectomy of lower half dilated by calculus and small papilloma. Definite line of demarcation and two sets blood- vessels. Secondary re- moval of remaining half seven months later because of per- sistence of pain. Found only moderately thick- ened renal pelvis	Well 11 years after operation.
3	Braasch & Scholl, <i>Idem.</i>	Female, 41	Symptoms left renal in- fection and multiple shadows. Two ureter- al orifices on each side. Poor function of lower half of left kidney	Diagnosis of double kid- ney with multiple sha- dows in lower half con- firmed by pyelography	Heminephrectomy of hydronephrotic lower half containing several calculi. Obstruction of this half by anomalous vessel. Four weeks later compelled to re- move upper half be- cause of persistent in- fection of this half	Well three years after operation.

4	Braasch & Scholl, <i>Idem.</i>	Male, 46	Recurrent pyuria, hæmaturia and pain over right kidney. Single ureteral orifices both sides. Small amount pus from right kidney. Multiple shadows over kidney area	Diagnosis of double kidney with multiple shadows in dilated lower pelvis, made by pyelography	At first operation small papillary cyst-adenoma enucleated from cortex and two small calculi removed from lower pelvis. Secondary complete nephrectomy six months later because of infection both halves	Recovery.
5	Braasch & Scholl, <i>Idem.</i>	Male, 45	Recurrent left kidney colic, with pus and blood in urine. Shadow opposite third lumbar vertebra	Left hydronephrosis with calculi	At first operation found both pelves of double kidney moderately dilated. Both ureters obstructed by calculus. Two years later obliged to do complete nephrectomy	Recovery.
6	Braasch & Scholl, <i>Idem.</i>	Female, 30	Increased frequency and pain over left kidney. Left (single) ureteral orifice slightly eroded. Ureteral catheterization negative on both sides	Diagnosis of double kidney made by pyelography	First resected lower atrophic portion of double kidney. This showed microscopically typical tubercles. Later removed upper half	Recovery.

Unfortunately the end results of the cases included in Table III are not given, inasmuch as in Cases 2, 6, 7, 9, 11 and 12 the operated half was the seat of calculi and in Case 3 (Mirabeau <sup>47</sup>) a tuberculous half was drained. No doubt a number of these were operated later.

The fact that so many renal and ureteral anomalies are being diagnosed before operation leads one to hope that a great many more heminephrectomies will be reported in the future.

#### BIBLIOGRAPHY

- <sup>1</sup> Ann. mal. g. u., 1910, vol. xviii, p. 769.
- <sup>2</sup> Urol. & Cutan. Rev., 1918, vol. xxii, p. 533.
- <sup>3</sup> Journ. d'Urol., 1921, vol. xi, p. 155.
- <sup>4</sup> Journ. Urol., 1917, vol. i, p. 17.
- <sup>5</sup> Ziegler's Beitr., 1914, vol. lix, p. 539.
- <sup>6</sup> Journ. d'Urol., 1921, vol. xi, p. 155.
- <sup>7</sup> Bei. z. Path. Anat. d. Nieren, No. 1, 1884, Tübingen.
- <sup>8</sup> Deutsch. Zeit. Chir., 1913, vol. cxxi, p. 425.
- <sup>9</sup> Zeit. f. Urol. Chir., 1922, vol. ix, p. 87.
- <sup>10</sup> Traité de Anatomie.
- <sup>11</sup> Zeit. f. Urol., 1911, vol. v, p. 862.
- <sup>12</sup> ANNALS OF SURGERY, 1911, vol. liii, p. 82.
- <sup>13</sup> Reported by Schoenfeld & Friedl, Fort. a. d. Geb. Roent., 1915, vol. xxiii, p. 169.
- <sup>14</sup> Am. Journ. Dermat. & G. U. Dis., 1907, vol. xi, p. 233.
- <sup>15</sup> Virch. Archiv, 1877, 70, 490, 1878, vol. lxxii, p. 130.
- <sup>16</sup> Surg. Gyn. & Obst., 1922, vol. xxxv, p. 401.
- <sup>17</sup> Journ. d'Urol., 1921, vol. xi, p. 155.
- <sup>18</sup> Urol. & Cutan. Rev., 1918, vol. xxii, p. 553.
- <sup>19</sup> Surg. Gyn. & Obst., 1922, vol. xxxv, p. 401.
- <sup>20</sup> Berl. Kl. Woch., 1914, vol. li, p. 1641.
- <sup>21</sup> Virch. Arch., 1910, vol. cc, p. 487.
- <sup>22</sup> Quoted by Schwartz, Arch. f. Klin. Chir., 1895, vol. 1, p. 159.
- <sup>23</sup> Zeit. f. Urol, 1909, vol. iii, p. 207.
- <sup>24</sup> Zeit., 1914, vol. iii, p. 33.
- <sup>25</sup> Zeit., 1921, vol. vii, p. 259.
- <sup>26</sup> Journ. Urol., 1922, vol. viii, p. 185.
- <sup>27</sup> Frankf. z. Path., 1910, vol. v, p. 149.
- <sup>28</sup> Deutsch. Zeit. Chir., 1904, vol. lxxii, p. 613.
- <sup>29</sup> Budapest Orvosi Ujsag., 1911, No. 44; Abst. Zeit. Urol., 1912, vol. vi, p. 531.
- <sup>30</sup> Zeit. Urol., 1911, vol. v, p. 920.
- <sup>31</sup> Virch. Arch., 1910, vol. cc, p. 487.
- <sup>32</sup> Virch. Arch., 1907, vol. clxxxvii, p. 408.
- <sup>33</sup> Virch. Arch., 1877, vol. lxx, p. 490; 1878, vol. lxx, p. 130.
- <sup>34</sup> Urol. & Cutan. Rev., 1918, vol. xxii, p. 553.
- <sup>35</sup> Surg. Gyn. & Obst., 1922, vol. xxxv, p. 401.
- <sup>36</sup> Beitr. z. path. Anat. d. Nieren, No. 1, 1884, Tübingen.
- <sup>37</sup> Virch. Arch., 1906, vol. lxxix, p. 667.
- <sup>38</sup> Quoted by Schwartz, Arch. Klin. Chir., 1895, vol. 1, p. 159.
- <sup>39</sup> Arch. Klin. Chir., 1895, vol. 1, p. 159.

## DOUBLE KIDNEY

- <sup>40</sup> Surg. Gyn. & Obst., 1922, vol. xxxv, p. 401.
- <sup>41</sup> Zeit. f. Urol., vol. iii, p. 927, 1909.
- <sup>42</sup> Korrbbl., Schw. Aerzte, vol. xiii, p. 400, 1902.
- <sup>43</sup> ANNALS OF SURGERY, vol. lxviii, p. 294, 1918.
- <sup>44</sup> Surg. Clin., Chicago, 1918, vol. i, p. 1053.
- <sup>45</sup> Surg. Gyn. & Obst., 1922, vol. xxxv, p. 401.
- <sup>46</sup> Journ. Urol., 1922, vol. viii, p. 155.
- <sup>47</sup> Zent. Gyn., 1906, vol. xxx, p. 706.

# A METHOD FOR DETERMINING THE QUESTION OF DRAINAGE IN INTRA-ABDOMINAL INFECTION

BY ABRAHAM O. WILENSKY, M.D.

AND

BENJAMIN N. BERG, M.D.

OF NEW YORK, N. Y.

FROM THE SURGICAL SERVICE OF MOUNT SINAI HOSPITAL, NEW YORK, N. Y.

THE question of drainage in cases of acute intra-abdominal infection is of paramount importance. In practical surgery one is confronted with the much larger number of cases in which the characteristics of the local findings make the institution of drainage imperative; these include the various forms of perforative lesions associated with marked peritoneal contamination, frank abscesses and oozing surfaces. Aside from these, there remains a group of borderline cases in which the question of drainage always arises and for which the old dictum "when in doubt, drain" still holds good.

In this communication a simple rapid method is described to aid in the decision of primary closure or drainage in these borderline cases. The method consists in making smears directly from the surfaces of the involved viscus and from any peritoneal exudate which may be present at the time of operation. Utilizing a rapid stain, the presence, or absence, of organisms is determined microscopically. (In this study the culture method was utilized merely for control purposes.) Similar to the Carrel technic for the determination of the degree of infection in wounds, the method attempts to ascertain approximately the degree of infection of the operative field by the number of organisms found per microscopic field. With the observation of a sufficiently large number of cases the determination of the greatest number of organisms per field compatible with the safe primary closure of the peritoneal cavity becomes possible.

Cases of appendicitis were chosen for study because they constitute the most common form of intraperitoneal infection and present the problem of drainage most often. The total number of cases studied is 46. At Mount Sinai Hospital cases of appendicitis are classified as follows:

1. Acute catarrhal forms.
2. Chronic appendicitis; including chronic catarrhal forms, chronic obliterative forms, and those with peri-appendicular adhesions.
3. Acute diffuse inflammatory and suppurative forms; including so-called empyemata; with and without peritoneal exudate.
4. Perforative and gangrenous forms with and without peritonitis.
5. Thrombotic forms.

The question of drainage never occurs in the cases of groups one and two, and it is always possible to close the wound primarily. Cases in these groups

## DRAINAGE IN INTRA-ABDOMINAL INFECTION

have served for control purposes. Cases falling in groups four and five practically always need to be drained; these, too, have functionated as control observations.

The question of drainage comes up repeatedly in the cases composing group three. Many of these cases need to be drained; many of these cases frankly need not be drained. Between these latter two subgroups is a third subgroup containing the cases which concern us mostly in this report.

There were 11 cases of these borderline kind in the total number studied. The facts regarding the gross pathological appearance of the appendix and operative field, as compared with the visible bacteriological content of the smears made at operation, are as follows:

Gross Pathology	Smear
1. Acute suppurative appendicitis; mucosa deeply inflamed and covered with a purulent exudate; muscularis thickened; serosa inflamed.	Negative for organisms. Few pus cells present.
2. Acute diffuse inflammation; no exudate.	Negative for bacteria and pus cells.
3. Tip of appendix acutely inflamed for a distance of one inch; serosa covered with fibrino-plastic exudate.	Negative for bacteria and pus cells.
4. Acute suppurative appendix; mucosa necrotic; covered with purulent exudate; small serous peritoneal exudate.	Negative for bacteria and pus cells.
5. Acute empyema in a diffusely inflamed organ; serosa covered with fibrino-plastic exudate.	Negative for bacteria and pus cells.
6. Acute diffuse inflammation; serosa covered with fibrino-plastic exudate; small amount of free turbid peritoneal exudate.	Negative for bacteria and pus cells.
7. Acute diffuse inflammation; mucosa covered with purulent exudate; small amount of sero-sanguineous fluid present in peritoneal cavity.	Negative for bacteria and pus cells.
8. Acute suppurative appendicitis; mucosa covered with purulent exudate; muscularis thickened; serosa inflamed; no free fluid.	Negative for bacteria and pus cells.
9. Acute suppurative appendicitis; mucosa necrotic and covered with purulent exudate; muscularis thickened; serosa inflamed; small amount of thin free fluid present.	Negative for bacteria and pus cells.
10. Acute diffuse inflammation; small sero-purulent exudate.	Negative for bacteria and pus cells.
11. Acute diffuse inflammation; small fibrino-purulent exudate.	Occasional Gram-negative bacillus and few pus cells.

*Summary.*—In the foregoing 11 cases the gross pathology indicated an acute diffuse inflammatory reaction which in some went on to various grades of suppuration. Peritoneal exudates were present in some. In all, except one,

no bacteria were demonstrable in the smear; in the exception only an occasional organism was seen. No one of these cases was drained at the close of the operation and the post-operative course was uncomplicated in any way in any one of them.

In ten cases falling in groups four and five which were studied the facts were as follows:

Gross Pathology	Smear
1. Gangrenous appendicitis with abscess; thick foul pus present.	Many Gram-negative bacilli and Gram-positive cocci in chains and clumps. Many pus cells.
2. Gangrenous appendicitis with perforation and purulent peritonitis.	Many Gram-negative bacilli and Gram-positive cocci. Many pus cells.
3. Gangrenous appendicitis with perforation and peritonitis.	Many Gram-negative bacilli and many pus cells.
4. Acute suppurative appendicitis with fibrino-purulent peritonitis.	Many Gram-negative bacilli and many pus cells.
5. Gangrenous appendicitis with perforation and diffuse peritonitis.	Many Gram-negative bacilli; fusiform and spiral forms (saprophytes); pus cells.
6. Gangrenous appendicitis with perforation and diffuse peritonitis.	Occasional Gram-negative bacillus; pus cells.
7. Acute suppurative appendicitis with diffuse peritonitis.	Many Gram-negative bacilli; pus cells.
8. Gangrenous appendicitis with perforation and diffuse peritonitis.	Many Gram-negative bacilli; pus cells.
9. Gangrenous appendicitis with perforation and diffuse peritonitis.	About 10 Gram-negative bacilli and Gram-positive cocci per field; pus cells.
10. Acute suppurative appendicitis with thick fibrino-purulent exudate.	About 2 Gram-negative bacilli per field; pus cells.

*Summary.*—In the foregoing ten cases in which drainage was frankly indicated, numerous bacteria were demonstrated in the smears in a uniform manner.

The cases originally classified in groups one and two at the beginning of this report are not described in detail, inasmuch as no one would ever think of draining such cases except under the most extraordinary of accidents. Bacteriologically these were all negative. These cases, too, were considered as control observations.

The method employed in making the smears is the following: Materials required: (1) thoroughly cleaned and dried platinum loop and two slides sterilized with the operating instruments; (2) alcohol lamp; (3) microscope with oil immersion lens; (4) cedar oil; (5) blotting paper; (6) Gram stain. The one employed has been in use in the laboratory for a great many years. It is prepared as follows:



Anilin-water gentian violet: No. 1, gentian violet, 8.0; alcohol, 95 per cent., 100.0; mix well.

No. 2. Anilin oil, 28.0; HCl, 5.0; distilled water, 900.0; shake well and filter through wet paper. Mix No. 1 and No. 2. Filter again. (Solution will keep for months.)

Gram's iodine: Iodine, 1 part; potassium iodide, 2 parts; water, 20 parts. Dilute 30 c.c. of above in 420 c.c. of water or in similar ratio.

Aquæous fuchsin: Twelve per cent. aquæous solution of saturated alcoholic basic fuchsin.

*Procedure.*—The operation is conducted in the usual manner. When the appendix is isolated and before the appendicular artery is ligated or the mesenteriolum is incised, the platinum loop is placed in contact with the entire surface of the appendix (especially the tip and base). If free fluid is present, two smears are made, one from the surface of the appendix and one from the peritoneal exudate. If no fluid is present a drop of sterile water in the platinum loop facilitates the making of a smooth smear.

While the surgeon removes the appendix, the smear is dried and fixed over the alcohol flame and stained with Gram's stain in the usual sequence; the various stains need, however, remain in contact with the smear for 15 seconds each (rapid method); the smear is then dried with blotting paper and examined under the oil immersion lens.

From the time the smear is made to the time a rapid careful examination of numerous microscopic fields is made and the result reported, no more than five minutes need elapse.

*Precautions:* (1) Smears should be made thinly and evenly. (2) The presence of blood in the smear interferes with the recognition of organisms. (3) Gross contamination due to various manipulations makes the method inapplicable.

Cultivations were made in every case studied in order to control the observations made in the smears. It is readily to be understood that for practical surgical purposes, culture methods would be of no use whatsoever because of the time factor. The facts in the culture studies made, are the following. *Media:* One c.c. ascitic fluid; or 1 c.c. glucose bouillon. *Method:* At the time of making the smears a loopful of material from the surface of the appendix and from the peritoneal exudate, when the latter was present, was introduced into either of the two media. Within one to two hours, preferably immediately, blood agar mixtures were made from the latter cultures and plates were poured. In 24 to 48 hours the number of colonies per loopful of material could be estimated.

*Observations:* In the borderline group of cases: Cases 1, 2, 3, 5, 6, 7, 8, 9, culture sterile. Case 4, *B. coli*; colonies too numerous to count. Case 10, *staphylococcus aureus*; 50 colonies to the loopful. Case 11, *B. coli*; 5 colonies per loopful.

In the control cases (group 4 and 5) previously detailed, the cultivations uniformly showed the presence of *B. coli*; the number of colonies were

too numerous to count in all cases; there may have been other organisms present which, apparently, were overgrown by the colon group of organisms.

*Comment and Conclusions.*—A preliminary report is made concerning the utilization of the direct smear as a practical criterion in deciding the question of drainage after operations for intra-abdominal infections (appendicitis with and without peritonitis).

The bacteriologic content of smears carefully made at the time of operation may be used as a rough estimate of the degree of infection of the peritoneal cavity. Up to the present time the studies have shown that when such smears show an absence, or only the occasional presence (one organism in five or more high-power microscopic fields) or organisms, cases of intra-abdominal infection (cases of appendicitis in this series) can be closed without drainage after operation without untoward post-operative complication. The statement holds true in the absence of any other surgical contraindication to drainage such as hemorrhage or oozing surface.

Cultures made at the same time as the smears may show a growth even when no organisms are visible in the smear. In such cases the number of organisms present is undoubtedly small and the nature of our results indicates that in the cases studied the peritoneum and natural defense mechanism of the body are ample to take care of the contamination. This does not take into account the virulence of the individual organisms.

The studies will be continued and a further report will be made as to the upper limit of the number of organisms per microscopic field compatible with a safe primary closure.

## REDUPLICATION OF THE URETER

By JOSEPH F. GEISINGER, M.D.

OF RICHMOND, VA.

FROM THE STUART CIRCLE HOSPITAL

IN a paper before the Medical Society of Virginia in 1916, subsequently published in *ANNALS OF SURGERY*, vol. lxxv, p. 355, the writer exhibited three instances of unilateral complete duplication of the ureter occurring in a series of one hundred cases subjected to cystoscopic investigation of certain urinary symptoms.

In the succeeding 400 cases of the same type four additional anomalies have appeared:

1. A ureter bifurcated in the upper fourth, with a common orifice at the vesical end and with separate independent pelves at the renal end.
2. Complete unilateral duplication, uncomplicated.
3. Complete unilateral duplication with multiple calculi in the normal pelvis on each side and dilatation of the rudimentary pelvis on the duplicated side.
4. Complete bilateral duplication, uncomplicated.

It is with particular reference to the last case that the present report is made, though the desirability of a general review of the field, with emphasis upon certain important clinical aspects of the anomaly, seems warranted at this time.

*Frequency of the Anomaly.*—The complicated embryologic processes which finally eventuate in the production of a normal anatomical entity become disarranged, in a greater or lesser degree, in a higher percentage of instances than is commonly recognized. It is our custom to think and act in terms of basic anatomy. The introduction of an aberrant element is therefore immediately confusing and sometimes disastrous, since failure to apprehend it may lead not only to diagnostic errors, but occasionally to surgical crises. A certain number of hepatic ducts have been cut due to ignorance or contempt of the fact that in a considerable percentage of instances this duct is not in its accustomed anatomical relationship with its fellows. Similarly two ureters may be explored and found negative while an undiscovered third may lead to the seat of a lesion for which the patient thereupon goes untreated.

It is interesting to note that such aberrant elements are more common in the genito-urinary system than in any other part of the body, and that of the various anomalies present here the duplicated ureter is perhaps the most frequent. The incidence, three per cent., in the writer's original report, has not been maintained in the succeeding series, but, without regard to the probability that he has himself overlooked some, the percentage in 500 cases is still 1.4.

The embryologic basis of the anomaly has been well worked out by Kelly and has been previously described by the writer. It need be only casually reiterated in this report which is essentially clinical in its application. The ureter originates as an offshoot from the Wolffian duct, the bud growing and dividing distalward until pelvis, calyces, and straight uriniferous tubules are produced and finally become united with the secreting portion of the kidney which is elaborated by an independent group of cells of different origin. Precocious division of this off-shoot may result in a Y-shaped canal, each limb leading to an independent pelvis, as exhibited in Case IV. This condition is fairly common. Irregular division at a higher level may produce anomalies of lesser note with individual large calyces, pelves of unusual shapes, etc.; these are being constantly observed. The explanation of complete duplication, however, with an independent pelvis at one end and an independent bladder orifice at the other, is not so easy. Of the various theories advanced the simplest appears to be the most likely, namely, that there is a double evagination from the Wolffian duct instead of one. The writer is not aware of any authentic report which would indicate the possibility of a true supernumerary kidney or a fusing together of two kidneys on one side. Complete unilateral duplication of this sort (Cases I, II, III, V, and VI) though not common, is not rare, and quite a large number of instances have been reported. Complete bilateral duplication, however (Case VII), is much more unusual and relatively few cases have appeared in the literature.

The rotation of the kidney in its ascent to the lumbar fossa produces usually a characteristic crossing of the duplicated ureters. Kelly describes one point of crossing and Braasch two. In one of our cases there was no crossing; in one instance there were three points of crossing, and in all others two; in no case was there a single point of crossing. If the two buds come off from the Wolffian duct simultaneously, or nearly simultaneously, the lower ends will be found close together in the bladder; if a longer interval prevails, they are further apart, and one of them may even come to lie in the urethra. In our cases the orifices were always closer together. One of the duplicated pelves is usually of rudimentary size.

The recent elaborate and impressive report by Braasch from the Mayo Clinic constitutes probably the most important clinical survey of this subject. In the presence of figures of such dimensions one hesitates to submit the few cases here recorded. The writer presents them with the sole idea that they perhaps exhibit certain features which may contribute something of interest if not value to the rapidly accumulating data.

*Summary of Cases.*—CASE I.—Miss M. G., white, female, unmarried, aged thirty. Right urinary tract negative. On left side two vesical orifices situated about one-quarter inch from each other. Pyelo-ureterogram with leaded catheters in position showed complete duplication on left side (Figs. 1 and 2), the median ureter crossing the lateral a short distance above the bladder and recrossing it a short distance below the pelvis, which was higher placed and much smaller than the other. This patient had a pyelitis which was limited to the rudimentary pelvis and which promptly cleared up under lavage.

## REDUPLICATION OF THE URETER



FIG. 1.—Upper Tract  
Case I.—Unilateral reduplication, with infection limited to rudimentary pelvis illustrated in Fig. 1. Cure following lavage.

FIG. 2.—Lower Tract



FIG. 3.—Upper Tract  
Case V.—Unilateral reduplication without pathology. Course of duplicated ureters shown but satisfactory pyelogram could not be obtained.

FIG. 4.—Lower Tract



FIG. 5.—Upper Tract  
Case III.—Unilateral reduplication with infection limited to one of duplicated pelvis. Cure following lavage.

FIG. 6.—Lower Tract

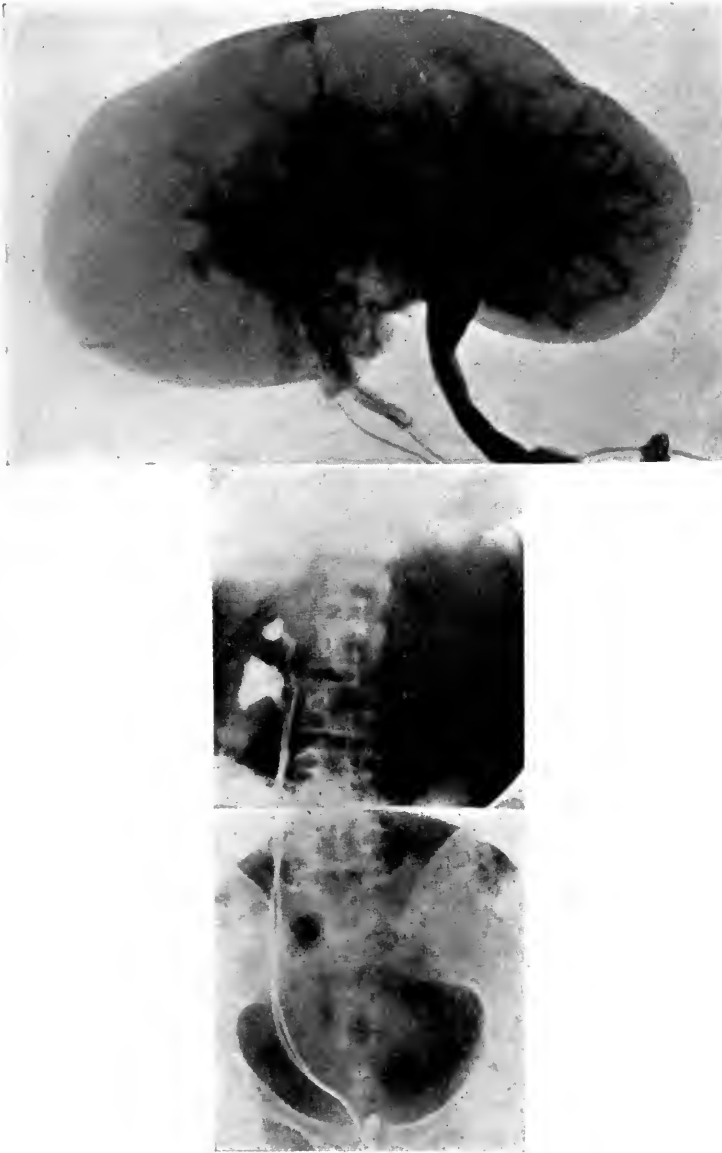
CASE II.—Mrs. M. C., white, female, widow, aged thirty-eight. Left urinary tract negative. On right side, close together, were two ureteral orifices, one of pin-point size. Pyelo-ureterogram with leaded catheters in position showed complete duplication on right side with double crossing of ureters, the median ureter leading to a pelvis higher situated than the others and both pelvic shadows being atypical (Figs. 8 and 9). Infection was present in both of the right pelves and the left side was normal; the rudimentary ureter was sharply contracted. For years this patient had been a semi-invalid with right-sided pain for which she had undergone a series of ineffective operations, including appendectomy, separation of adhesions, colectomy, hysterectomy and exploration. Following lavage of the right renal pelves, enlargement of the orifice of the rudimentary ureter, and dilatation of the ureter itself, she was free of pain for more than twelve months. Her trouble then began to recur and though subsequent dilatation of the right ureters always produced definite results the free intervals became shorter and shorter. Finally, when she had become nearly bed-ridden the writer performed a nephrectomy since which time, after some vicissitudes due to the condition of her frequently explored abdomen, she has practically entirely recovered her health. An injection of this kidney was made after its removal (Fig. 7); in spite of the small amount of solution used (3 to 5 c.c.) the bromide can be traced through the ramifications of the minute tubules; a lesson in the dangers of pelvic lavage when conducted with a syringe.

CASE III.—J. N. C., white, male, married, aged twenty-four. Left urinary tract negative. On right side two vesical orifices situated close together, one slightly anterior and medianward to the other—which is the usual relationship. Pyelo-ureterogram with leaded catheters in position showed complete duplication on this side (Figs. 5 and 6). The supernumerary pelvis appeared more normal in size and shape than the others in this series. The patient came in for vesical disturbance due to cystitis, secondary to a staphylococcic infection limited to the pelvis attached to the right lateral ureter. Under local treatment of the bladder, the usual internal medication and lavage of the infected pelvis with silver nitrate, he promptly recovered.

CASE IV.—Mrs. J. E. S., white, female, married, aged forty-eight. Nothing unusual seen in bladder. Bilateral pyelogram showed kink in right ureter which, with its pelvis, was otherwise normal; on left side there was a bifurcation of the ureter at the level of the top of the fourth lumbar vertebra and each limb of the ureter then ascended to a separate pelvis. The ureter from the upper pelvis appeared to be dilated. This patient came in for persistent left lumbar pain so severe as to make her a chronic invalid. An exploratory operation was done. The double pelves were demonstrated and the two stems of the ureter were found to coalesce about one and one-half inches below the kidney. The upper ureter was sharply constricted by an aberrant vessel which was divided. An incision was made into the ureter near the junction of its branches and further exploration was made with a No. 9 bulbous bougie. No constrictions being located the kidney was returned to its position. Subsequently this patient developed a recurrence of her pain and underwent a secondary operation elsewhere; at that time it was stated that the true capsule of the kidney was found to have been stripped off from the parenchyma and distended by an accumulation of bloody fluid so that the kidney lay in a sac composed of its own capsule, from which it was separated by about an ounce of this fluid. The operator stripped the capsule off completely and then restored the kidney to its normal position. Shortly after the operation the patient was reported free of pain. She has not been heard from since.

## REDUPLICATION OF THE URETER

CASE V.—Miss M. J. C., white, female, unmarried, aged twenty-two. Right urinary tract negative with exception of what appeared to be a stricture in the ureter, probably responsible for the right sided pain which brought her to the

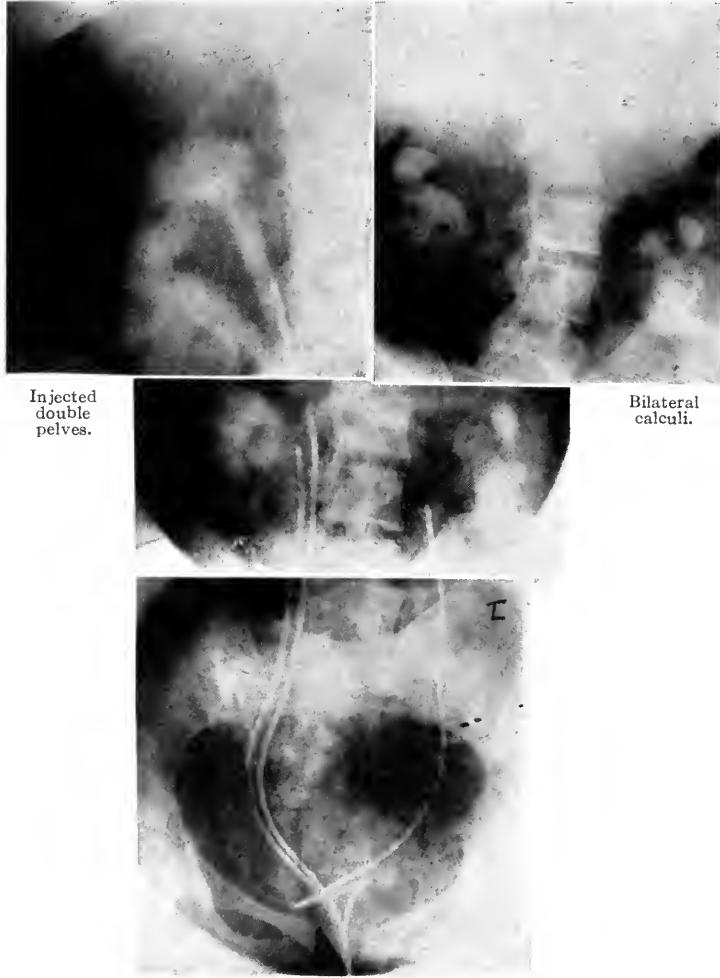


FIGS. 7, 8 and 9.—Unilateral reduplication. Small plates, together, show entire course of duplicated ureters, terminating in separate pelves. In this case persistent pain and infection ultimately required nephrectomy. After its removal kidney was injected and is shown in large plate above. Note diffusion of bromide through tubules. (Case II.)

hospital. On left side, in close approximation, were seen two ureteral orifices, one being exceedingly small. Pyclo-ureterogram (Figs. 3 and 4) with catheters in position, showed complete duplication on left side with the usual double crossing

of ureters. The right pelvis was well filled. The intolerance of the patient to manipulation prevented satisfactory filling of the left pelvis. No infection was present on either side and the patient had no symptoms referable to duplicated pelvises. She has not returned for further observation.

CASE VI.—Mrs. T. J. W., white, female, married, aged thirty-five. It is interesting to note in this remarkable case that the patient came not for pain or



FIGS. 10, 11, 12 and 13.—Unilateral reduplication with bilateral calculi. Two plates below show courses of duplicated ureters. Above on reader's left is pyelogram of duplicated side, showing dilatation of rudimentary pelvis; on right is plate covering both sides of upper tract and showing collection of large calculi on each side. (Case VI.)

serious bladder disturbance but for indigestion, anorexia, and a tendency to miscarriages, of which she had had about seven. A routine analysis disclosed a large amount of pus and further inquiry brought out the fact that she at times had some frequency and straining, but the vesical symptoms were so mild that she had paid very little attention to them. Cystoscopic examination revealed a chronic cystitis. The left ureteral orifice was normal. On the right side, close



## REDUPLICATION OF THE URETER

together, were two orifices. Pyelo-ureterogram showed complete duplication on this side. There was no crossing of the ureters in this case. There was an enormous collection of calculi in both of the normal pelves. The rudimentary pelvis and its ureter were sharply dilated but seemed to be free of stones. All three pelves were infected. The functional dye output from the right lateral ureter was 4 per cent. in 15 minutes (normal 15 per cent.): from the right median



FIG. 14.  
Right pelvis.



FIG. 15.  
Left pelvis.



FIG. 16.—Showing course of ureters. Case VII.—Bilateral complete reduplication of ureters and pelves without pathology.

ureter a bare trace and from the left ureter 4 per cent. The condition was considered non-surgical and the patient has been lost sight of. (Figs. 10, 11, 12 and 13.)

CASE VII.—Mrs. B. D. P., white, female, married. Patient came in for investigation of cause of frequency of urination for which no explanation could be offered except a low-grade trigonitis visible through the cystoscope. Normal ureteral orifices were present on both sides and above each was a barely visible indentation suggesting possible supernumerary orifices. Probing disclosed the presence of four ureters, all of which were then catheterized. Pyelo-ureterograms (Figs. 14, 15 and 16) showed complete duplication on both sides. On the right

side the ureters crossed three times and on the left twice. The capacity of the pelvis was small and the upper pelvis presented the usual rudimentary appearance.

The functional dye output from the four ureters in 15 minutes was as follows:

R. Lower ureter 5 per cent. Upper ureter  $11\frac{1}{4}$  per cent.

L. Lower ureter 5 per cent. Upper ureter  $6\frac{1}{4}$  per cent.

No infection was present and the patient had no symptoms which could be charged to the anomaly.

*Clinical Considerations.*—It has been stated occasionally that pathologic processes are but rarely encountered in kidneys presenting duplications of the pelvis and ureter. As a general physiological proposition it would be more rational to assume the reverse, since any anomaly to some degree alters the normal body economy and thereby invites trouble. In our series of seven cases, five, or 71 per cent., presented definite pathology, namely: Infection, two cases; infection and stricture, one case; disabling pain due to obstruction by aberrant vessel, one case; multiple calculi, one case. \*It is true that in certain cases the pathologic process is of such a character as to indicate an independence of the associated anomaly; in certain others, however, there appears to be a definite relationship between the two. Certainly the series demonstrates the absence of any immunity to complications which appears to have been assumed in some quarters in connection with this type of case.

The diagnostic difficulties created by ureteral anomalies will be easily understood. The simple bifurcated ureter, of course, presents in the bladder no evidence of its existence and its discovery is usually accidental. Nevertheless this condition can occasion as much anatomical confusion as the ureter duplicated throughout, and, in view of its concealment from inspection, may be responsible for even greater difficulties of diagnosis than in the other types. It is wise therefore in any case in which the data is clouded by some element not obvious after the usual methods of examination to add to it a pyelogram made with a plugging catheter low in the ureter so as to demonstrate graphically the conditions existing at the other end. When the ureter is duplicated throughout and the supernumerary orifice is situated elsewhere than in the bladder, *i.e.*, in the urethra or vagina, the clinical picture and therapeutic considerations are different from those presented in this review and therefore need not be detailed further than to state that both accurate diagnosis and surgical remedy are possible. When the ureter is duplicated throughout and the supernumerary orifice is located alongside its fellow in the bladder, the only excuse for misinterpretation lies in the fact that the extra orifice is frequently so minute that under the best of circumstances it may be overlooked, while in the presence of inflammation and œdema it is altogether invisible. The essential thing to be borne in mind is that the anomaly occurs with sufficient frequency to make it imperative to include its consideration in routine cystoscopy. Ordinarily after one ureter has been located and catheterized on each side the job is considered complete, but it may be very incomplete. The writer now invariably inspects the trigone with

## REDUPLICATION OF THE URETER

especial reference to additional ureters—and in the presence of any unusual findings does so with great care. It is important to make this inspection before catheters are put into the normal ureters as the zone of congestion which sometimes encircles the orifice after catheterization may seriously obscure the field; or the third orifice may be so close to its fellow as to be completely thrown out of the line of vision by the slight elevation of the mucosa produced by the catheter. In the course of the inspection any suspicious points, however small, should be explored with a fine bougie. Quite often the supernumerary orifice is literally of pin-point size.

It will be readily seen that an infection in a third pelvis will remain untreated unless the pelvis itself is discovered. The pole of the kidney lodging the undiscovered pelvis may be the primary seat of a neoplasm or a tuberculosis, producing hæmaturia or tubercle bacilli in the urine, the source of which remains a mystery to the physician and a progressing menace to the unfortunate patient. The question of accurate diagnosis here therefore is of more than mere theoretical importance. The patient's life may hang in the balance at times. Furthermore, the presence of the anomaly may materially influence the surgical procedure. If it be accurately demonstrated in advance that a pathologic process requiring nephrectomy is present in one of a pair of pelvises, the other remaining unaffected, it is entirely possible where such conservatism is warranted, to resect the involved portion of the kidney with its pelvis and ureter, leaving the remainder to continue its normal function.

## A MODIFICATION OF THE OPERATION OF BUCKNALL FOR HYPOSPADIAS

BY SAMUEL CLARK HARVEY, M.D.

OF NEW HAVEN, CONN.

FROM THE SECTION OF SURGERY, YALE UNIVERSITY

THAT the operative procedures for the cure of hypospadias, occurring at any point from the peno-scrotal junction to the glans, are not in any great degree uniformly successful, is indicated by the number and variety of procedures described. Churchman,<sup>1</sup> as late as 1920, reviewed twelve orthodox methods or groups of methods, submitted them to a critical analysis, and found them all deficient in one or more details essential to the success of any plastic procedure.

For this criticism one is referred to the original article, but it may not be superfluous to state again the requisites of a plastic which may promise success. These are: (1) In case of failure the patient must not be left in a worse condition than originally. (2) Raw surfaces rather than cut edges must be secured for approximation. (3) Tension on tissue must be avoided. (4) Circulation of flaps must be preserved. (5) In general, flaps must be held without the aid of elaborate retention dressings as these are seldom efficient. (6) The repair of the actual defect should be done in one stage, as secondary attacks are always more difficult and less likely to succeed. (7) Flaps should be overlarge to allow for contracture in order to obtain a desirable late result. (8) The opportunity for infection should be reduced to a minimum.

A study of the orthodox procedures in the light of this critique shows only one operation which is thoroughly sound, and that is Bucknall's,<sup>2</sup> the principles of which were originally described by Landerer and Bidder. This procedure is simple and can be readily understood by reference to figure 1, in which (A) represents the lines of incision and (B) the turnback of the flap. The penis is then flexed upon the scrotum and the analogous portions of the urethral and cutaneous flaps approximated by the suture as shown in figure 2 (A) and (A'). The actual reconstruction of the urethra is thus accomplished in one stage and the secondary operation consists only in freeing the penis from the scrotum as shown in figure 3 (a) and (c). This operation was applied by both Bucknall and Churchman to the peno-scrotal hypospadias, but has not been used in those defects present on the shaft or at the base of the glans which after all comprise the larger group.

The advantages as stated by Bucknall are as follows:

(1) The operation is performed in two stages, each of which can be rapidly accomplished. (2) The skin utilized to form the roof and floor of the new urethra is not dissected up or even touched; consequently it retains its

## OPERATION OF BUCKNALL FOR HYPOSPADIAS

vitality and does not tend to slough as when flaps are used for this purpose. (3) No sutures project into the lumen of the new urethra. (4) The skin of the roof and floor of the new urethra is respectively in continuity with the roof and floor of the previously existing one. There is in consequence no tendency to the formation of a fistula or a stricture at the site of the false meatus as so frequently happens when other methods are employed. (5) No buried sutures are necessary and the apposition of the broad raw sur-

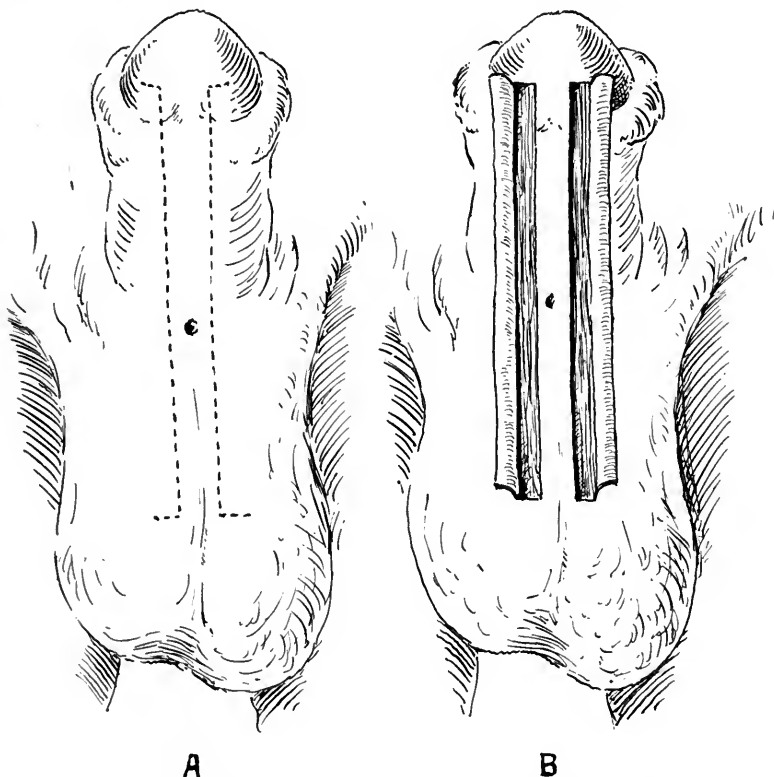


FIG. 1.—The original procedure of Bucknall. A. The lines of incision.  
B. The flaps turned back.

faces afforded by the flaps on either side supported by the rubber tubing prevents any tendency to leakage.

It is the purpose of this paper, to describe a modification of Bucknall's method as developed during the attempts at the application of this procedure in two patients with hypospadias of the shaft of the penis. The conditions which were met and the methods employed are as follows:

CASE I.—H. B., a boy of thirteen, entered the hospital with a malformation of the penis which was present at birth. He had undergone an operative procedure in another hospital some seven months previously, for a hypospadias opening directly beneath the glans at the point where the frænum is usually found. Previously to that time he had had no difficulty with urination aside from the abnormal direction of the stream. Subsequent to the interference he

suffered from a great deal of difficulty in this respect; the urine appearing only in drops and requiring a long time and considerable effort to empty the bladder. There was also some dribbling and difficulty in retaining the urine so that he soiled his clothing most of the time. He entered the hospital for the relief of this condition and was otherwise normal.

On local examination it was evident that an attempt had been made at a plastic repair, probably of the Duplay type. The prepuce was large and redundant over the dorsum but not fused beneath the glans and the frænum was absent. Extending from the middle of the shaft to the glans was a scar resulting from

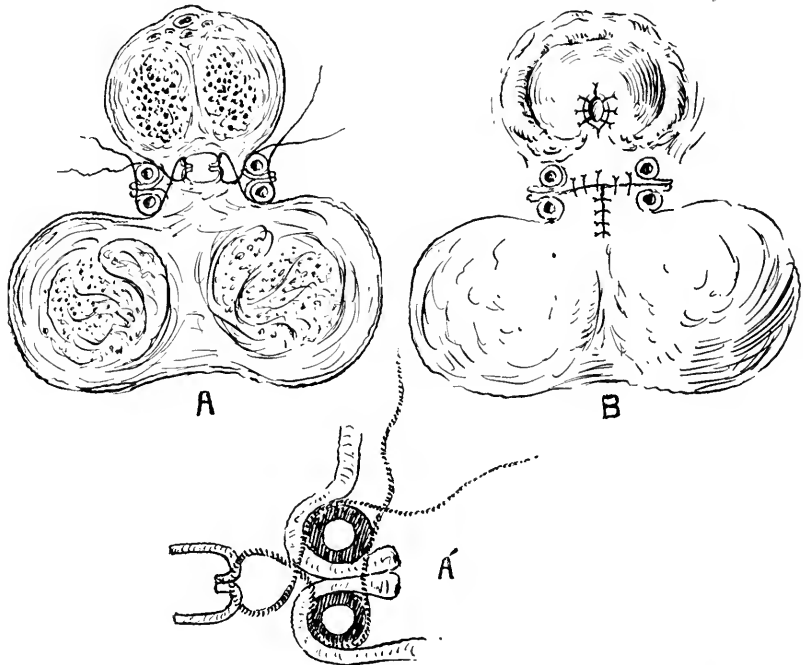


FIG. 2.—A. Penis fixed to scrotum and new urethra in cross section. B. The same, showing glans and meatus as restored by a modification of Bucknall's operation. A'. Suture in detail.

the previous operation. At the distal end of the scar was a small opening situated at the base of the glans on the ventral aspect, from which an occasional drop of urine was seen to trickle. From this point there extended a groove along the ventral aspect ending in a small depression at the normal site of the urinary meatus. On attempting to pass a filiform bougie, a stricture was met directly behind the operative meatus. The operation had resulted in carrying the opening forward on to the ventral surface of the glans, but, by reason of the stricture, had resulted in a very much worse condition than that present previous to the interference, a not uncommon result from the type of procedure used.

The indication for operation now seemed to be an attempt at cure of the stricture; consequently a filiform was introduced and an attempt made to dilate the stricture sufficiently to admit a urethrotome. It was found at once that the scar tissue and skin were so intimately adherent that inevitably such dilatation would at once rupture the urethra and adjacent skin, thus reproducing the hypospadias. There seemed no alternative to this, so the urethra was laid open as far as the scrotum and the first stage of the Bucknall procedure carried out. In other words, the anterior stricture was converted into a peno-scrotal hypos-

## OPERATION OF BUCKNALL FOR HYPOSPADIAS

padias as a preliminary to the actual repair. The convalescence was uneventful and the patient left the hospital in eleven days, discharging urine through the new urethra without any difficulty.

Four and one-half months later he was asked to return for the freeing of the penis from the scrotum. It was found that the opening of the urethra was at the base of the glans in the usual position of the frænum and that the attachment of the scrotal flaps over the lower part of the glans had not held, inasmuch as the epithelial covering of that structure was not sufficiently thick to provide viable flaps. With the freeing of the penis, then, it was necessary to carry the

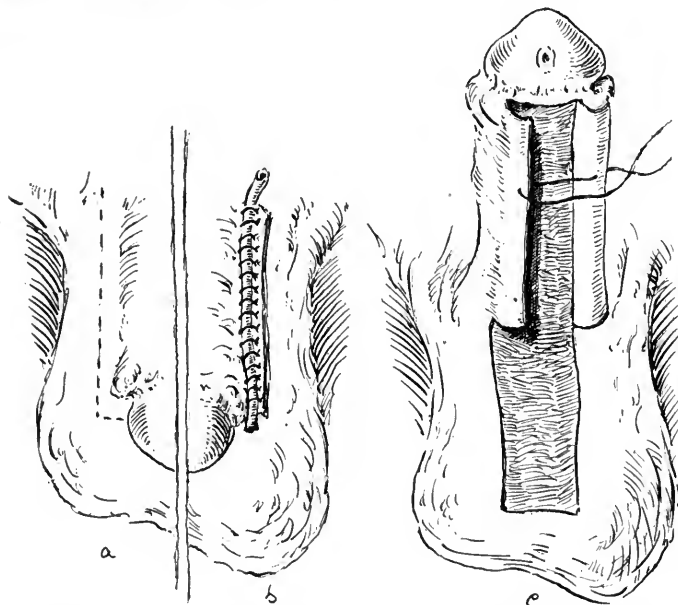


FIG. 3.—a. Line of incision for freeing the penis from the scrotum. b. The suture line following the completion of the first stage. c. Appearance following the freeing of the penis from the scrotum and previous to the suture.

new urethra to its usual site of opening on the glans. The method of accomplishing this is shown in figure 4. The penis was finally freed from the scrotum as described in the second stage of the procedure and the anterior surface reconstructed. The patient had a somewhat protracted convalescence, interrupted by an alveolar abscess but was discharged from the hospital twenty-two days after the operation with the wound healed. He voided with a large stream from the new urethral opening in the glans.

CASE II.—G. C., a boy aged eleven, entered the hospital with a hypospadias a short distance beneath the glans and a complaint of bed-wetting. The past and family histories contained nothing of significance and the physical examination revealed no abnormalities aside from that noted, which had been present since birth. The penis was of normal size and the prepuce short and retracted with a small canal at its lower edge. He was said to have been circumcised when an infant. The frænum was absent and 1 cm. beneath the glans on the ventral aspect of the penis was the opening of the urethra. At the site of the normal urethral opening there was a dimple which on probing was seen to open into a minute vestigial remnant of the urethra, leading through the glans to the ventral aspect of the penis.

Because of the facility with which a cure was accomplished in the previous case, the same procedure was carried out here. The urethra was opened to the scrotum, thus converting the deformity into a peno-scrotal hypospadias, and the first stage of the Bucknall done. Again there was difficulty in developing the flaps on the glans of the penis and consequently the new urethra ended just beneath the corona. There was a slight amount of infection which rapidly subsided and the patient was discharged sixteen days later voiding satisfactorily through the new urethra. He entered the hospital again a month and a half later for a plastic to carry the urethra through the glans. A similar method to that used in

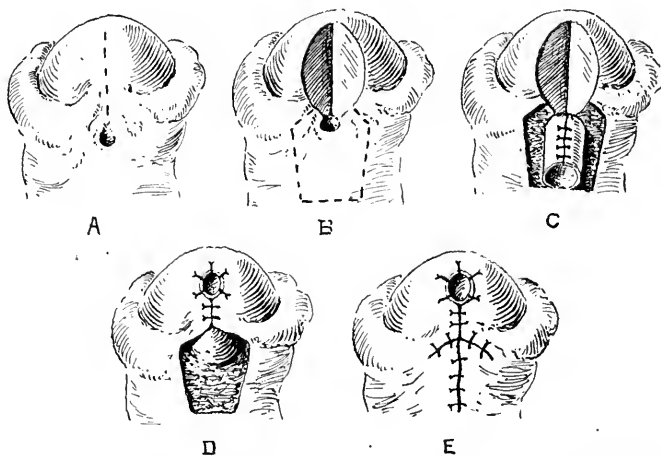


FIG. 4.—A. Incision of glans. B. Incision of flaps. C. Cuff turned up and sutured. D. Cuff inverted into opening in glans and sutured in place. E. Closure of defect made by formation of flaps.

the first case was employed but in this patient the tube of the skin was carried through the glans after dilating markedly the minute passage. The wound healed readily but with a small leak just beneath the glans. He was discharged fifteen days after the operation voiding freely from the new urethral opening in the glans with a few drops appearing at the site of the fistula. Because of attendance at school, he did not enter the hospital again until the following year, at which time the condition was much the same as on discharge. The penis was freed from the scrotum and the minute fistula touched with carbolic. The wound healed per primam and on discharge eleven days later there was no leak and a free passage through the reconstructed meatus.

The methods of attack of these two cases were not ideal, inasmuch as they were extemporized at the time and arose in part from conditions unforeseen. In two points in particular the rule for the proper performance of a plastic was transgressed. Firstly, the opening of the urethra to the base of the scrotum would, in the case of failure, leave the patient, theoretically at least, worse off than at the start. Secondly, the deferring of the reconstruction of the portion of the urethra lying in the glans until the second stage was incorrect in principle, and I believe inadvisable in practice. The original procedure of Bucknall caused the flap to be mobilized forward over the glans, but it was found practically impossible to raise flaps sufficiently thick because of the nature of the epithelial covering of the glans and as a result the urethral opening came to lie at the corona.



## OPERATION OF BUCKNALL FOR HYPOSPADIAS

The remedies for these defective steps now seem obvious. In the first place, the hypospadias does not need to be converted into a peno-scrotal lesion as regards the urethra. It is only necessary to mobilize the skin flaps as in the original Bucknall procedure and the urethra may be let alone. The method of doing this is shown in figures 5 and 6. Secondly, the reconstruction of the portion of the urethra lying in the glans is done by a modification of the Mayo method; that is, by tunnelling through the glans and the introduction of a tube formed by skin flaps obtained from the scrotum. This is best carried

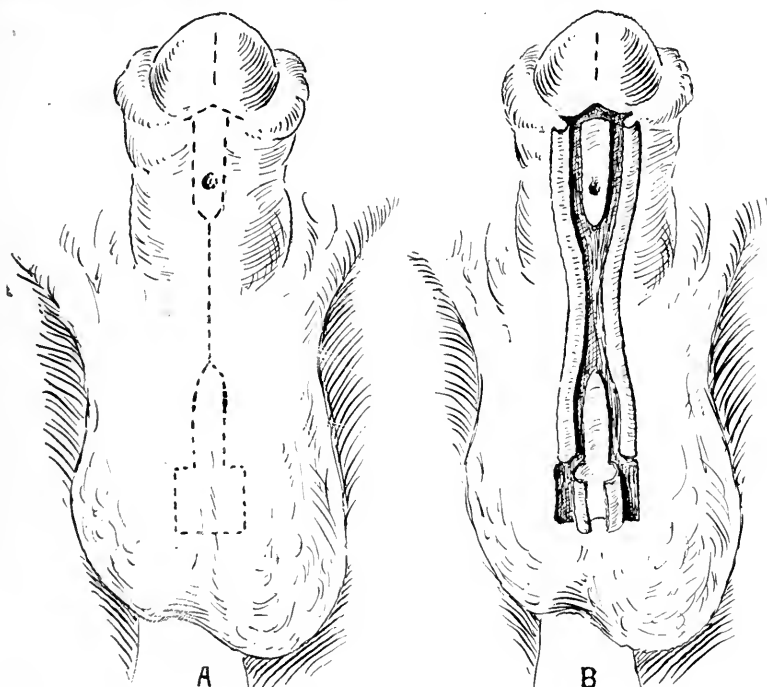


FIG. 5.—Hypospadias of shaft of penis, modification of Bucknall's operation. A. Lines of incision. B. Formation of flaps.

out during the first stage of the Bucknall procedure, and is shown in figures 5, 6, and 7. In this manner skin flaps for the new urethra can be formed with a good pedicle without any rotation and with a minimum of damage. The tube so formed will, I am sure, "take" with uniformity.

The procedures then, offering the greatest chance for success and accomplishing the greatest degree of restoration to the normal in the various types of hypospadias are as follows: In a peno-scrotal hypospadias the procedure of Bucknall with the reconstruction of the portion of the urethra in the glans is shown in figure 7. In a hypospadias with the opening in the mid-portion of the shaft, the modification as demonstrated in figure 5 and in the coronal hypospadias that suggested in figure 6.

Certain details are worth emphasizing. All skin flaps should be approximated with broad surfaces of contact and this is best done by suturing over

small rubber tubing as shown in figure 2 (A), (B), and (A'), and figure 3 (b). Sutures should not be tied too tightly but allowance made for the subsequent swelling. The suture is a figure of 8, best done with fine silk, as shown in figure 2 (A), and not passed through the new flaps of the new urethra, but at the edge in such a fashion as to invert them. These sutures are removed in from four to six days. No buried sutures are used except in the tunnel flap for the urethra in the glans, where a few double zero catgut stitches are employed, chiefly to hold the flaps in approximation while the tube is being passed through the tunnel. The slit in the glans must be made overlarge,

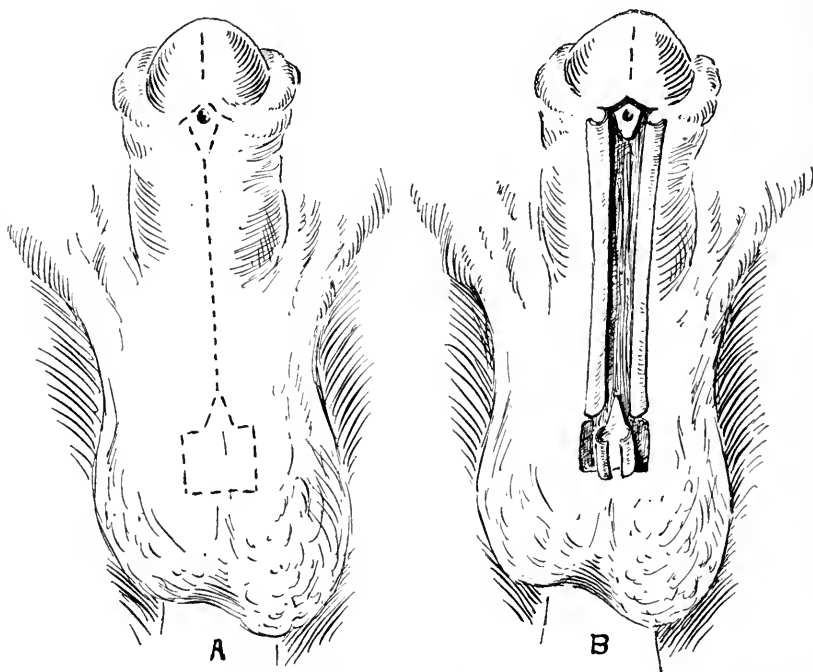


FIG. 6.—Hypospadias, coronal. Modification of Bucknall's operation. A. Lines of incision. B. Formation of flaps.

that there may be no choking of the tunnel flap when swelling takes place, and it is best to place a small soft rubber catheter through the penile urethra for 48 hours to insure the patency of this. The catheter should be fenestrated in such a fashion as to insure flow, and, if there is any suggestion of blocking, removed at once, and if necessary a small glass female catheter inserted through the glans.

The advantages of this procedure with its modifications are that it meets all the essentials of a plastic procedure and in such a fashion, that a successful result can be predicted with considerable assurance. In addition, it is not necessary to do an external urethrotomy for posterior drainage and the normal urination takes place in a few days after the first operation. There is no interference of the urinary tract in the second stage. Excessive swelling and oedema of the penis does not take place because the skin is slit to the scrotum

## OPERATION OF BUCKNALL FOR HYPOSPADIAS

so that there is no constrictor effect and resultant exaggeration of the swelling. As a consequence of this stitches do not tend to cut out nor flaps pull apart. The disadvantage of the procedure is, as far as I can determine, mainly theoretical, and that the possibility of the growth of hair in the new urethra. The scrotal flap which alone may carry hair, should be cut along the median raphé, which is nearly if not quite hairless in most individuals. For one to whom this may seem an insurmountable obstacle, depilation by the X-ray offers a ready solution.

*Summary.*—Modifications of the Bucknall operation for peno-scrotal hypospadias are described which make this principle applicable also to the penile

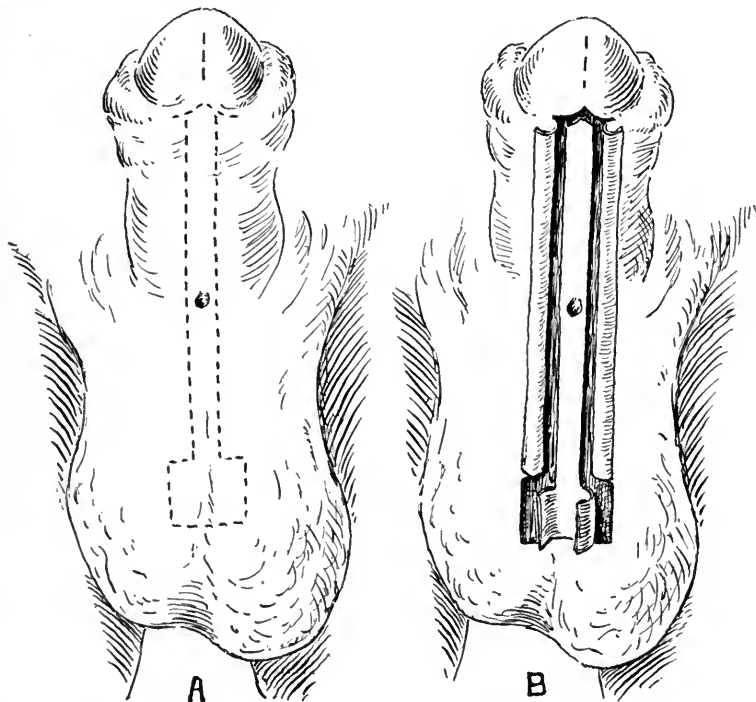


FIG. 7.—Hypospadias, peno-scrotal. Modification of Bucknall's operation. A. Lines of incision. B. Formation of flaps.

and coronal malformation of the urethra. A method is described also for carrying the distal urethra through the glans, rather than on its under surface, as originally suggested.

## REFERENCES

- <sup>1</sup>Churchman, John W.: Hypospadias with Particular Reference to the Operation of Bucknall. *ANNALS OF SURGERY*, 1920, vol. lxxi, pp. 486-492.
- <sup>2</sup>Bucknall, Reuben P. H.: A New Operation for Penile Hypospadias, *Lancet*, 1907, vol. ii, pp. 887-890.

## BENIGN TUMORS OF THE STOMACH

By JOHN DOUGLAS, M.D.

OF NEW YORK, N. Y.

THE occurrence of benign tumors in the stomach is rare in comparison with carcinoma of that organ. Its relative infrequency is shown by the fact that in 7500 autopsies in the Oubuchow Krankenhaus, only four cases of polyp of the stomach were found. (Quoted by Campbell.) Eusterman and Senty report 27 cases of benign tumor of the stomach under observation at the Mayo clinic between 1907 and 1921. During this period operations were performed on a total of 2168 cases of malignant disease of the stomach or a proportion of 1 to 78. Therefore 1.3 per cent. of all gastric tumors were benign. They call attention to the fact that even this percentage of frequency is relative, as during the same period 2285 additional cases of malignant neoplasms, the majority of them inoperable, passed through the clinic.

During the period between 1910 and December 31, 1921, 170 cases of carcinoma of the stomach were operated on in St. Luke's Hospital. There were four cases in which benign tumor of the stomach were found at operation. One other case that had no operation is reported from autopsy. The following is a brief report of these cases:

*Case Reports:*—CASE I.—M. C. No. 108833, a woman sixty-seven years old, was admitted to the hospital, September 27, 1915. She gave a history of anorexia, dizziness, loss of strength and the loss of 14 pounds weight in the previous two or three months. She had slight nausea at times but never vomited. She complained of feeling heavy after eating and of frequent attacks of diarrhoea. Gastric analysis showed an absence of free hydrochloric acid. A radiograph, which was taken previous to her admission to the hospital, showed a peculiar mottling due to various filling defects throughout the stomach which was most marked in the pars media. This picture is now recognized as characteristic of gastric polyposis, as shown excellently in the radiograph of the case reported by Balfour. But as the case here reported was under observation previous to any report of similar cases, the diagnosis of carcinoma of the pars media of the stomach was made.

An exploratory operation was done and the stomach found free from adhesions or induration, but palpation demonstrated the presence of small soft masses inside the stomach as if it were full of undigested particles of food. Incision through the anterior stomach wall showed almost the entire mucosa covered by adenomatous polypi, varying in size from a small pea to a large grape, most marked in the middle portion of the stomach. The masses were soft and friable, some single, some in bunches of three or four. A number of these polypi were ligated at the base and removed for examination. It was obvious, that, as practically the whole stomach was involved from the cardia to the pylorus, a resection was impossible.

Radium treatment was attempted by means of enclosing 60 mm. of radium in a capsule to which a string was attached. The patient swallowed this capsule

## BENIGN TUMORS OF THE STOMACH

and it remained in the stomach for six hours, her position being changed from time to time to bring the radium into contact with various portions of the stomach. That this was accomplished, was demonstrated by a number of radiographs which were taken with the patient in different positions.

Microscopical report of the specimens removed is as follows: "There is hyperplasia of the mucosa with congestion of the blood-vessels. The glands are greatly increased in number and in tortuosity, with many cystic dilatations in their ducts. Cylindrical cells line them. There is a small amount of fibrous stroma throughout the mucosa."

The patient had severe pain at times, following operation, vomited occasionally and for two or three weeks after operation had diarrhoea which was difficult to control. She left the hospital about a month after the operation but died three months later; her pre-operative symptoms continuing and gradually becoming worse, up to the time of her death.

CASE II.—P. C., No. 114,979, a man forty-four years old, was admitted to the hospital, August 16, 1916. He never had any symptoms up to three or four months previous to his admission to the hospital. He then had indigestion and vomited three or four times during the three months when he ate solid food. He complained of no pain but lost 18 pounds in weight. Examinations showed a mass in the epigastric region and the radiograph a 24 hour residue and filling defect. Diagnosis of carcinoma of the stomach was made and gastric resection done. There was a large ulcerating carcinoma in the pyloric portion of the stomach, and at a distance from this carcinoma on the posterior wall of the stomach, separated from the edge of the carcinoma by an area of normal mucosa, was a papillomatous growth about one centimeter in diameter.

This patient improved after operation, gained 27 pounds in weight and felt as well as ever, but shortly after this time he began to again lose weight and strength, and died about 15 months after operation of a recurrence.

CASE III.—W. D., No. 133,514, a man fifty years old, entered the hospital, February 7, 1919. He gave a gastric history of eight months duration. There was retention of bismuth in the stomach for six hours and a filling defect of the lesser curvature, but no mass could be felt. Pre-operative diagnosis was gastric carcinoma. Operation revealed a large callous ulcer on the lesser curvature which was adherent to the surrounding structures and a gastro-enterostomy was determined on. The interior of the stomach was examined through the gastro-enterostomy opening. A papilloma about 1.5 cm. in diameter was found attached to the anterior wall of the stomach near the pylorus, surrounded by normal mucous membrane. The papilloma was excised and its base sutured with chromic catgut and a posterior gastro-enterostomy performed. Pathological report showed a characteristic adenopapilloma of the stomach. The patient vomited a large amount of brownish fluid, evidently containing blood, for several days following the operation. He had repeated attacks of hiccough and died on the ninth day after operation. Whether the post-operative hemorrhage was from the base of the papilloma, his ulcer, or the gastro-enterostomy stoma, was never determined, as no autopsy was permitted.

CASE IV.—K. S., No. 135,150, a woman fifty-two years old, entered the hospital, April 28, 1919, with a four months' history which was characteristic of cholelithiasis. At operation a large stone and several smaller stones were found in the gall-bladder and a cholecystectomy was done. On the anterior wall of the pyloric portion of the stomach was a small white subserous tumor about .5 cm. in diameter which was excised, apparently a fibroma. Macroscopically, the tumor seemed circumscribed, but microscopically could be seen invading the muscle tissue on all sides and contained a small area of cystic degeneration at its periphery. Diagnosis was fibroma of the stomach wall.

The first case reported of gastric polyposis presents, according to Eusterman and Senty, the rarest form of benign tumor of the stomach, the only case reported in their article being the one described in detail by Balfour, in which case the multiple polypi appeared to be confined to the pyloric end of the stomach. In writing of this case, Eusterman states that Carman had only seen two cases in 50,000 Röntgen-ray examinations of the stomach, one case reported by Balfour and the other by Meyer. H. E. Ruggles has also reported a case of "Unusual Gastric Polyp." This tumor was described as of papillomatous rather than adenomatous structure.

J. N. T. Finney and J. Freedwald have reported two cases of gastric polypi which had undergone malignant degeneration. This is of interest in

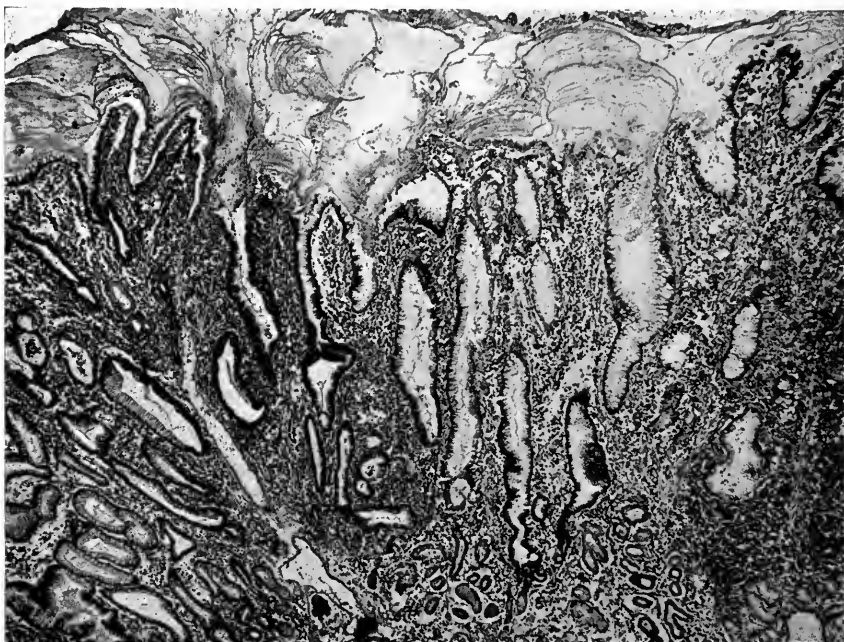


FIG. 1.—Case I. Gastric polyposis. High power.

connection with Cases II and III, in the series reported in this article. In Case II, a single papilloma was found in the patient operated on for carcinoma. While at a distance from the carcinoma, it is not impossible that the carcinoma originated in another papilloma of the stomach, although this cannot be proved. In Case III, the papilloma was at a distance from a large callous ulcer on the lesser curvature. This patient died as a result of his operation. No autopsy was allowed and it is not known whether the ulcer was carcinomatous or not. In the two cases reported as "gastric polyposis" by Finney and Friedenwald, there was a single papillomatous mass in each case. In both cases carcinoma had developed, and as these cases differ both macroscopically and microscopically from the multiple polypoid growths

described in Case I and in the reported cases of Balfour and Meyer, they should not be reported as gastric polyposis.

Macroscopically the tumors found in gastric polyposis appear smoother, are more sessile than the papillomatous growths, and resemble grossly polypi, such as are found in the uterus or nasal cavity. Microscopically the difference is well described by the following report by Dr. L. C. Knox, resident pathologist of St. Luke's Hospital. This report also explains why the papillomatous growths are apt to become malignant while the polypoid growths are less likely to do so.

"In the polypoid adenoma from Case I, we have small, rounded, sessile tumors, the surface covered with rather shallow glands showing only hyper-

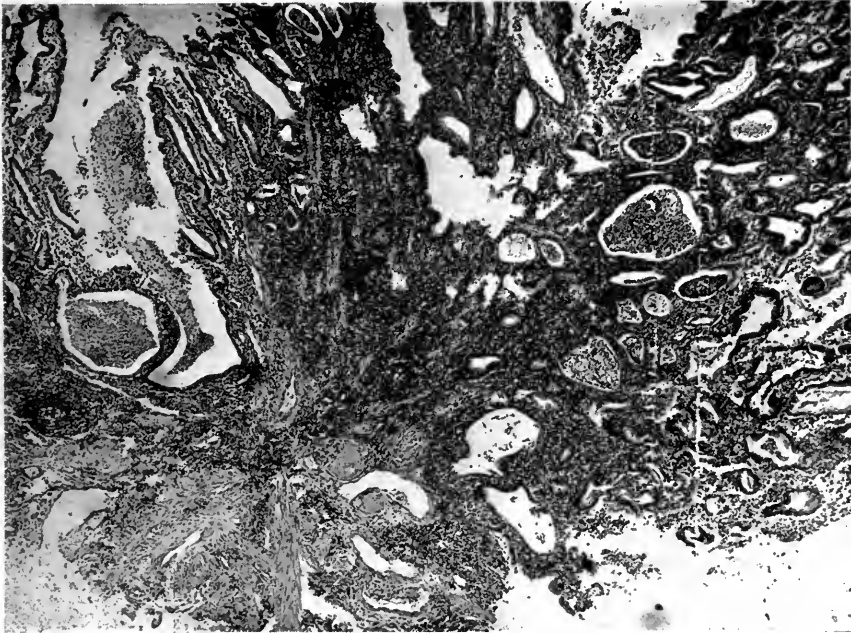


FIG. 2.—Case III. Adenopapilloma. High power.

plasia extending not below the muscularis mucosa and composed of comparatively regular acini, lined with epithelium which is hyperplastic but closely resembles the mucosa of the normal stomach and show no tendency to infiltrate. These cells are distended with very large quantities of mucus which also covers the surface. (Fig. 1.) The specimen of papillary tumor from Case III has a small base, is composed of extremely irregular glands, lined with epithelium which does not resemble the normal and tends to produce very little mucus, the greater portion of the cell body being occupied by the nucleus which is itself large, irregular, and deeply stained. Although infiltration of the basement membrane cannot be seen, the acini are comparatively elongated and irregular and this frequently suggests infiltration where it cannot be proven." (Fig. 2.)

The following case report of a patient dying in the medical ward of the hospital in the service of the late Dr. A. W. Hollis, is of considerable interest in relation to the degeneration of benign papillomata: such as is described in the cases of Finney and Friedenwald:

CASE V.—H. S., No. 136,341, a man thirty-eight years of age, was admitted to the medical ward of the hospital on June 23, 1919. He complained of pain in the abdomen, relieved by food. He never vomited. He had marked weakness and had been unable to work for the previous six or seven months. There was an absence of free hydrochloric acid in the stomach, there was blood in the stools, and a radiograph showed two areas of lessened density in the stomach but no diagnosis was made. There was no six-hour gastric residue. His hæmoglobin was 29 per cent. and red blood cells, 2,800,000. Morphology of the blood showed pernicious anæmia. He improved while in the hospital under transfusions and other treatment, and left the hospital after three months to go to the country and convalesce. He returned three months later to the hospital. Although his anæmia was much improved, he still had blood in his stools and no free hydrochloric acid in the stomach. About one month after admission he developed a high temperature, some abdominal rigidity and finally died, 22 days later. At autopsy it was found that he had a low grade peritonitis which had apparently spread from a small perforation in the stomach. There were a number of papillomata growing from the stomach mucosa. And the most interesting finding was that while microscopical examination of these papillomata indicated no malignancy, the regional glands showed carcinomatous metastases.

The last case reported, Case IV, that of fibroma, was a purely accidental finding, as it caused no symptoms, the patient being admitted and operated upon for cholelithiasis. These tumors, however, frequently attain a large size.

Histologically, benign tumors of the stomach may be of almost any type. In Eusterman's series there were three leiomyomata, three adenoleiomyomata, four fibromyomata, five fibromata, four hæmangiomas, two dermoids, one case of polyposis, two adenomata, two adenomatous polypi and one case of multiple papilloma.

Myomata of the stomach are apparently among the most common of benign tumors as, in addition to the ten cases of different types of myoma reported by Eusterman and Senty, Farr and Glenn collected 84 cases in 1913, and F. Nasetti in 1914 brought the number of cases of leiomyomata of the stomach reported up to 140. These tumors may reach a large size, as the one of 6000 gms., reported by Perls and Neelsen, and are apt to become cystic and undergo sarcomatous degeneration. In addition to tumors of the histological types previously mentioned, lipomata, usually of small size, have been reported by Virchow, Von Russdorf and Benaky. They may be single or multiple.

In the vast majority of cases pre-operative diagnosis is not made, as there is little that is characteristic, with the exception of the radiographic picture caused by gastric polyposis. In many instances the tumor is found as a result of an operation for some other condition, although pyloric stenosis may be caused, and Wade has reported a case in which intussusception into the stomach and the duodenum was due to a pedunculated fibro-adenoma. Cases in which an adenomatous polyp obstructed the pylorus have been



reported by Tuffier, Chiari, and by Cornil as early as 1863, and by Chaput, Gibson, and Blake. Fenwick reported a case in which four pedunculated adenomata of pigeon-egg size, attached near the pylorus, caused partial obstruction. In addition to causing pyloric obstruction such adenomatous polypi may cause continued hemorrhage of a sufficient degree to resemble pernicious anæmia and undergo carcinomatous degeneration, as shown by the case record and autopsy reported in this article, Case V.

Portions of polypi have been found in the stools, vomitus and lavage from the stomach and diagnosis made thereby. There is usually achylia gastrica as a symptom in the various types of polypoid growths in the stomach, and the vomitus or lavage return frequently contains a large amount of mucus and attention has been called to the peculiar egg-white appearance of this mucus. Benign tumors of the stomach may occur at any age, and in Eusterman and Senty's series, an equal number of cases were found in patients above and below the age of forty.

*Summary.*—I. Five cases of benign tumor are reported. One of multiple polyposis, three of papillary adenoma, of which one had undergone malignant degeneration, and one fibroma. The patients' ages varied from thirty-eight to sixty-seven.

2. Almost any type of benign tumor which might take its origin from the different stomach layers may be found. The various forms of myomata have been most frequently reported and appear to attain the largest size. Multiple gastric polyposis is the least frequently met with. The myomata and fibromyomata may become cystic or undergo sarcomatous degeneration. The papillary adenomata may become carcinomatous. There is a histological difference between the true multiple polypoid tumors and the papillary adenomata.

3. A pre-operative diagnosis is infrequently made, the smaller tumors usually causing no symptoms. The radiographic appearance of gastric polyposis, and the achylia gastrica with the egg-white mucus in the lavage return, however, is characteristic of this lesion. In other forms of benign tumor the symptoms or diagnosis may depend on a palpable tumor, anæmia due to repeated hemorrhages, or the appearance of a portion of the tumor in the vomitus, stool or lavage return. Symptoms of pyloric obstruction may result from a tumor in the region of the pylorus. Intussusception through the pylorus has been reported in two cases.

4. There is nothing characteristic or diagnostic to be learned from gastric analysis except in multiple polyposis, as it varies from achylia gastrica to hyperacidity.

5. Radiographic examination shows a six-hour residue less frequently than in cases of carcinoma except in the case of tumors which obstruct the pylorus. A large tumor would cause the same radiograph picture as is shown by a carcinoma. Occasionally a persistent defect might cause the suspicion of a tumor as in Case V, or an extragastric tumor may cause a defect in the outline of the stomach.

6. A generalization or summary of the operative indications is difficult, as benign tumors differ in histology, size, as to whether they are extrinsic, intrinsic, infiltrating or pedunculated, are symptomless or causing any of the symptoms described, or are of the types which may undergo malignant degeneration. Surgical removal of the tumor should be done when indicated by symptoms, or when diagnosis can be made either before or at the time of operation. With the exception of those cases in which multiple tumors are present, the technical difficulty is usually less than in malignant disease, because of absence of infiltration and ulcerations, and metastases in regional glands. The ultimate prognosis is better, as if the benign tumor is successfully removed, recurrence will not occur.

## BIBLIOGRAPHY

- <sup>1</sup> Balfour: Surg., Gyn. and Obst., 1919, vol. xxviii, p. 465.
- <sup>2</sup> Benaky: Lipome de l'Estomac. Bul. et mem. de la Soc. de Chir. Paris, 1905, p. 817.
- <sup>3</sup> Blake: ANNALS OF SURGERY, 1907, vol. xlv, p. 130.
- <sup>4</sup> Campbell: Surg., Gyn. and Obst., 1915, vol. xx, p. 66.
- <sup>5</sup> Chaput: Jour. Societe Anatomique, 1895, p. 534.
- <sup>6</sup> Chiari: Wiener klin. Woch.
- <sup>7</sup> Cornil: Note sur les Polypes de l'Estomac, Societe Anatomique, 1863, p. 582.
- <sup>8</sup> Eusterman and Senty: Surg., Gyn. and Obst., 1922, vol. xxiv, p. 5.
- <sup>9</sup> Farr and Glenn: N. Y. Med Jour., 1913, vol. xcvi, p. 1351.
- <sup>10</sup> Fenwick and Salto: Cancer and Other Tumors of the Stomach, London, 1902.
- <sup>11</sup> Finney and Friedenwald: Gastric Polyposis, Am. Jour. Med. Sc., 1917, vol. cliv, pp. 683-689.
- <sup>12</sup> Gibson: ANNALS OF SURGERY, 1907, vol. xlv, p. 130.
- <sup>13</sup> Meyer: Jour. Am. Med. Ass'n., 1913, vol. li, p. 1960.
- <sup>14</sup> Nasetti: Tumori, 1914, vol. iv, No. 3—abst. Jour. Am. Med. Ass'n., 1915, vol. lxiv, p. 867.
- <sup>15</sup> Perls and Neelsen: Allg. Pathol. Studgart, 1886, p. 288.
- <sup>16</sup> Ruggles: Unusual Gastric Polyp, Jour. Roentgenol., 1920, vol. vii, p. 356.
- <sup>17</sup> Tuffier: Chirurgie de l'Estomac, Paris, 1907.
- <sup>18</sup> Virchow: Traite des Tumors.
- <sup>19</sup> Von Russdorf: Lipom des Magens, Deutsch klin. Wochnschr., 1867, p. 115.
- <sup>20</sup> Wade: Intussusception of the Stomach and Duodenum, due to a Gastric Polypus, Surg., Gyn. and Obst., 1918, vol. xvii, p. 184.

## GALL-BLADDER DISEASE IN CHILDHOOD

BY EDWARD LELAND KELLOGG, M.D.

OF NEW YORK, N. Y.

GALL-BLADDER infection has usually been considered a disease of middle age. It is the purpose of this paper to show that the condition is by no means as infrequent in early life as supposed, that it can usually be diagnosed if kept in mind, and to review the literature of the subject.

In September, 1921, the following case came under my care in Gouverneur Hospital.

*Case Report.*—J. B., female, aged eleven, born in Poland. Family history negative. Previous history: One previous attack, never had typhoid nor other infectious disease. Present illness commenced three days ago with constipation, nausea, vomiting and general abdominal pain, most severe in upper right quadrant.

*Examination.*—Temperature 100.4, pulse rapid. The child was evidently in severe pain which was referred to the epigastrium and upper abdomen. There was general tenderness more marked about the navel and under the right costal arch, and general rigidity particularly of the upper right rectus. There was no jaundice.

Immediate operation was performed. Through a right rectus incision the appendix and gall-bladder were inspected and excised. The former was thickened and adherent. It was evidently the seat of chronic inflammation. The latter was thickened, oedematous, imbedded in adhesions, and contained thick dark bile with fifty-two gall-stones, several of them the size of a pea. Recovery was uneventful and complete.

This experience led to a review of the literature of cholecystitis and cholelithiasis in childhood, starting with a report by Gibson<sup>1</sup> in 1722. Sixty-four cases have been collected. It is probable that there are many others which have not been recorded.

In the United States no attention has been paid to the subject beyond a recent valuable paper by Farr<sup>48</sup> (1922) and the case reports of Eisendrath<sup>40</sup> in 1917. In England Thompson<sup>28</sup> (1898) and Still<sup>29</sup> (1899) have written briefly but interestingly on the subject and Thudichum in his treatise on gall-stones (1863) discussed the etiology.

In Germany a few cases have been reported and a brief review was published by Khautz<sup>41</sup> in 1913.

The French writers have given more attention to the subject and the papers of Massie<sup>10</sup> (1880), Mercat<sup>22</sup> (1884), Serveniere<sup>42</sup> (1889) and Mangin<sup>15</sup> (1869) are worthy of study.

The appended table presents a summary of sixty-three cases abstracted from the literature of the subject together with the author's case now reported.

*Statistical Summary.*—SEX.—Male, 25; female, 18; not stated, 21. Total, 64.

TABLE PRESENTING SUMMARY OF ABSTRACTED CASES

No. of case	Date	Author	Sex	Age	Autopsy	Operation	Stones	Jaundice.	Cholecystitis	Other pathology	Other symptoms	How diagnosed
1	1722	Gibson	Male	12 yrs.	Yes	No	Yes	No	No	Ascites	Pain, loss of weight and strength, vomiting	Autopsy.
2	1752	Coe	Unknown	Under 12 yrs.	.....	.....	Yes	.....	.....	.....	.....	.....
3	1767	Lieutaud	Male	25 days	Yes	No	Yes	.....	.....	Liver enlarged	Colic	Autopsy.
4	1813	Portal	Unknown	Infant	Yes	No	Yes	Yes	.....	Liver infiltrated with blood	.....	Autopsy.
5	1813	Portal	Unknown	Infant	Yes	No	Yes	Yes	.....	Liver infiltrated with blood	.....	Autopsy.
6	1813	Portal	Female	15 yrs.	Yes	No	Yes	Yes	No	.....	Indigestion, depression, cedema-limbs	Autopsy.
7	1822	Beverhoit	Male	13 yrs.	Yes	No	Yes	.....	.....	.....	.....	.....
8	1822	Beverhoit	Unknown	Under 13	.....	No	.....	.....	.....	.....	.....	.....
9	1829	Du Cruveilhier	Unknown	5-6 mos.	.....	No	Yes	.....	.....	.....	Tuberculosis	.....
10	1829	Du Cruveilhier	Unknown	Very young	.....	No	Yes	.....	.....	.....	Constipation, abdomen swollen, rigid, tender	.....
11	1830	Orfila	Female	14 yrs.	Yes	No	Yes	Yes	Yes	.....	.....	Stones found in faeces.
12	1834	Lolotte	Male	15 yrs.	No	No	Yes	.....	.....	.....	.....	.....
13	1838	Valleix	Unknown	Newborn	Yes	No	Yes	.....	.....	.....	.....	Autopsy.
14	1838	Valleix	Unknown	Newborn	Yes	No	Yes	.....	.....	.....	.....	Autopsy.
15	1838	Valleix	Unknown	Newborn	Yes	No	Yes	.....	.....	Commencing obliteration of common duct, thick black bile	.....	Autopsy.
16	1843	Bouisson	Unknown	Newborn	Yes	No	Yes	.....	.....	.....	.....	.....
17	1861	Trousseau	Female	9 yrs.	No	No	No	.....	.....	.....	Typical symptoms of gall-stones	From symptoms.
18	1861	Wolff	Male	10 yrs.	No	No	Yes	.....	.....	.....	.....	Stones observed in faeces.
19	1861	Ferich	Female	7 yrs.	Yes	No	Yes	.....	.....	Lardaceous disease of liver	.....	Autopsy.
20	1864	Royer	Unknown	5 yrs.	Yes	No	Yes	No	No	Peritonitis, perforated appendix, ducts dilated	Symptoms of peritonitis	Autopsy and analysis of calculi.
21	1869	Mangin	Female	11 yrs.	Yes	No	Yes	Yes	Yes	.....	Attacks of colic with intermittent fever	Autopsy.
22	1870	Senac	Unknown	5-10 yrs.	.....	.....	.....	.....	.....	.....	.....	Diagnosis made with certainty.
23	1870	Senac	Unknown	5-10 yrs.	.....	.....	.....	.....	.....	.....	.....	Diagnosis made with certainty.
24	1870	Senac	Unknown	5-10 yrs.	.....	.....	.....	.....	.....	.....	.....	Diagnosis made with certainty.
25	1877	Cuffer	Male	12 days	Yes	No	Yes	Yes	Yes	Gall-bladder reduced to size of small duct, Cystic and common duct obstructed by calculi	Hæmophilia	Autopsy.

# GALL-BLADDER DISEASE IN CHILDHOOD

26	1879	Anduard	Unknown	Under 4 yrs.	No	No	Yes	.....	.....	.....	Colic	Stones in feces.
27	1880	Massie	Female	4-5 yrs.	No	No	Yes	.....	.....	.....	Symptoms as in adults	Stone expelled.
28	1880	Massie	Male	8 yrs.	No	No	No	No	No	No	Hepatic colic quite characteristic	From symptoms.
29	1880	Beale	Unknown	8 mo. fetus	Yes	No	Yes	Yes	.....	.....	.....	Autopsy.
30	1882	Walker	Male	3 mos.	No	No	Yes	Yes	.....	.....	Colic	Stones in feces.
31	1884	Mercat	Male	10 yrs.	No	No	No	No	.....	.....	Attacks of severe epigastric pain, vomiting, tenderness over gall-bladder	From symptoms.
32	1884	Mercat	Male	11 yrs.	No	No	No	Yes	.....	.....	Biliary colic, fever, enlarged liver	From symptoms.
33	1884	Mercat	Female	3 yrs.	No	No	No	Yes	.....	.....	Abdominal pain, enlarged liver	From symptoms.
34	1884	Mercat	Male	3 yrs.	Yes	No	Yes	No	.....	.....	Symptoms of peritonitis	Calculus in appendix recognized as biliary calculus.
35	1884	Ricard	Unknown	Under 4 yrs.	No	No	Yes	.....	.....	.....	Colic	Stone in feces.
36	1884	Bond	Male	10 yrs.	Yes	No	Yes	No	.....	.....	Symptoms of typhoid fever	Autopsy. This was a case of empyema of gall-bladder secondary to the typhoid.
37	1801	Roth	Female	Infant	Yes	No	Yes	.....	.....	.....	.....	Autopsy.
38	1892	Naumyn	Female	14 yrs.	No	Yes	Yes	.....	.....	.....	.....	Stones found at operation.
39	1892	Treves	Unknown	10 yrs.	No	No	Yes	.....	.....	.....	Indigestion, vomiting, abscess of back from which calculus was discharged	Stone recognized.
40	1898	Thompson	Male	20 days	Yes	No	Yes	Yes	.....	.....	Abdominal pain, light stools, weakness	Autopsy.
41	1899	Still	Female	9 mos.	Yes	No	Yes	No	.....	.....	Vomiting, wasting, constipation, purpura	Autopsy.
42	1899	Still	Female	8 mos.	Yes	No	Yes	.....	.....	.....	Cerebral symptoms	Autopsy.
43	1899	Still	Male	5 mos.	Yes	No	Yes	No	.....	.....	Severe abdominal pain, pale stools, palpable liver	Autopsy.
44	1899	Still	Male	10 yrs.	No	No	No	Yes	.....	.....	Vomiting, abdominal pain, enlarged and palpable gall-bladder	Symptoms.
45	1905	Riedel	Male	9 yrs.	No	Yes	No	.....	.....	.....	Acute cholecystitis	Operation—no stones.
46	1909	Riedel	Female	13 yrs.	No	Yes	No	No	.....	.....	.....	Operation—no stones.
47	1908	Friedlander	Male	5 yrs.	No	Yes	Yes	No	.....	.....	Fever, colic, palpable tumor	Operation.
48	1908	Schlesinger	Unknown	4 mos.	Yes	No	Yes	Yes	.....	.....	Abdominal pain	Operation.
49	1908	Friedjung	Unknown	4 mos.	Yes	No	Yes	.....	.....	.....	Pain, tenderness, palpable tumor	Autopsy.
50	1909	Nontenbruck	Male	5 yrs.	No	Yes	No	No	.....	.....	.....	Operation.
51	1909	Cahoy	Female	13 yrs.	No	Yes	Yes	.....	.....	.....	Small fibrous gall-bladder	Operation.

TABLE PRESENTING SUMMARY OF ABSTRACTED CASES—(Continued)

No. of case	Date	Author	Sex	Age	Autopsy	Operation	Stones	Jaundice	Cholecystitis	Other pathology	Other symptoms	How diagnosed
52	1909	Wharton	Male	13 yrs.	No	Yes	No	No	Yes	Pus in gall-bladder. Acute appendicitis	Pain and tenderness in right hypochondrium, palpable gall-bladder	Operation, empyema of gall-bladder without stones, complicating appendicitis. Autopsy or operation.
53	1909	Stoelzner	Male	7½ yrs.	.....	.....	Yes	.....	.....	.....	.....	.....
54	1910	Neuman	Female	14 yrs.	No	Yes	Yes	.....	.....	.....	.....	Operation.
55	1910	Childs	Female	13 yrs.	No	Yes	No	.....	Yes	.....	.....	Operation, cholecystitis without stones.
56	1912	Marton	Unknown	2½ yrs.	No	Yes	No	.....	Yes	Much distended gall-bladder	Supposed intestinal obstruction	Operation.
57	1917	Eisendrath	Female	15 yrs.	No	Yes	Yes	Yes	Yes	Gall-bladder tense	Colic, temperature, rigidity	Operation.
58	1917	Eisendrath	Female	15 yrs.	No	Yes	Yes	.....	Yes	Chronic appendicitis	Severe pain upper right quadrant, vomiting, tenderness, palpable gall-bladder; catarrhal appendicitis	Operation.
59	1922	Farr	Male	13 yrs.	No	Yes	No	Yes	Yes	Appendicitis	Fever, pain, rigidity, tenderness	Operation.
60	1922	Farr	Male	8 yrs.	No	Yes	No	No	Yes	Appendicitis	Scarlet fever, tenderness, rigidity upper right quadrant	Operation.
61	1922	Farr	Male	8 yrs.	No	Yes	No	No	Yes	Multiple abscesses liver	Vomiting and pain, fever, leucocytosis	Operation.
62	1922	Farr	Male	7 yrs.	No	No	No	Yes	Yes	Ascites	Vomiting, chills, fever	From symptoms.
63	1922	Farr	Male	12 yrs.	No	Yes	No	No	Yes	Appendicitis	Pain, vomiting, tenderness, leucocytosis, fever	Operation and symptoms.
64	1922	Kellogg	Female	12 yrs.	No	Yes	Yes	No	Yes	Appendicitis	Fever, pain, rigidity, tenderness	Operation and symptoms.

AGES.—Fœtus (8 months), 1; newborn, 7; very young, 1; infant, 3; child, 1; less than 1 year, 6; between 1 and 5 years, 7; between 5 and 10 years, 13; between 10 and 15 years, 25. Total, 64.

CALCULI.—Present, 44; absent, 10; not stated, 10. Total, 64.

JAUNDICE.—Present, 16; absent, 16; not stated, 32. Total, 64.

CHOLECYSTITIS.—With stones, 12; without stones, 11; absent, 4; not stated, 37. Total, 64.

A study of these reports which cover the literature up to the present time shows that we can place the cases in three groups: Gall-stones in early infancy, gall-stones of later childhood, acute infections of the gall-bladder of hæmatogenous origin.

Still<sup>20</sup> has the following to say of the first group:

“As regards the etiology of gall-stones in childhood, one point seems to be of special importance, namely, the much greater tendency to formation of gall-stones during early infancy than in later childhood. It seems quite certain that in many, if not in all of the newborn cases, the calculi have actually been formed during intra-uterine life.

“It would appear therefore that some condition is present during intra-uterine life and early infancy which particularly favors the production of biliary concretions. This condition is perhaps to be found in the tendency to stagnation of bile in the gall-bladder which seems to exist at this period.

“In making a considerable number of autopsies on infants it has struck me, as it seems to have struck several of the writers on the anatomy of childhood, that the bile in the gall-bladder is often very viscid in early infancy, and such a viscosity would naturally favor, if indeed it be not the result of stagnation. That a mechanical hindrance which causes a stagnation of bile may be associated with the formation of calculi is shown by the cases in which a narrowing of the common duct was associated with the presence of calculi. Moreover, a potent cause of stagnation may exist in the muscular inactivity of this period: the contractions of the diaphragm in particular are probably completely in abeyance during intra-uterine life and the general movements of the body are extremely slight.”

There are three cases in this group in which at autopsy the common duct was found to be obstructed. It is possible that a similar lesion in other cases has been overlooked.

The cholelithiasis of later childhood does not appear to differ from that in adults. It is apt to be wrongly diagnosed because we are prone to regard gall-bladder infection as a disease of middle age. The possibility being kept in mind, it should offer only the ordinary difficulties of diagnosis.

Acute infections of the gall-bladder without the presence of gall-stones have been particularly stressed by Farr. Apparently it is usually a result of bacteriæmia secondary to some other infection, but in some of the cases no other infection could be found. It is necessary to remember that it may occur, as it creates a surgical problem of great importance.

The observations gathered are sufficiently numerous to indicate the importance of considering this affection, which is barely touched upon by the classical authors of diseases of childhood, and to lead to the conclusion that it is not so rare as has been generally believed.

*Summary.*—Sixty-four cases are reported. They are grouped under three headings: Cholelithiasis of early infancy. Cholelithiasis of later childhood. Cholecystitis without gall-stones.

Cholelithiasis in the newborn appears to be due to an unknown foetal pathology and is usually fatal.

Cholelithiasis of later childhood does not differ from that in adults, but is often wrongly diagnosed because this lesion is not considered.

Cholecystitis without gall-stones is an important surgical problem.

# BIBLIOGRAPHY

- <sup>1</sup> J. Gibson: Medical Essays and Observations, 2 obs., p. 30, 1722. (Quoted by Thudichum and by E. Little under name of Gibbons.)
- <sup>2</sup> Thos, Coe: A Treatise on Biliary Concretions. London, 1757, p. 67.
- <sup>3</sup> Lieutaud: Historia Anatomica Medica, 1767. (Still gives this reference as mem. Acad. de Med. Paris 1847, vol. xiii. This is, however, a quotation of the earlier paper.)
- <sup>4</sup> Portal: Maladies du Foie, Paris, 1813, p. 125.
- <sup>5</sup> Beverhoyt: Quoted in Dictionnaire de Méd., vol. iv, p. 59, 1822.
- <sup>6</sup> Du Cruveilhier: Traite d'Anatomie Pathologique, Anatomie Pathologique Atlas. Paris, 1829, p. 43.
- <sup>7</sup> Orfila: Quoted in Dictionnaire de Méd. et de Chir. Pratiques, 1830.
- <sup>8</sup> Lolatte: Medical Gazette of Paris, vol. D. No. 1, 1834.
- <sup>9</sup> Valleix: Maladie des Enfants, Paris, p. 316, 1838.
- <sup>10</sup> Bouisson: Icterus and Calculus in a Newborn Baby. Thesis, 1843.
- <sup>11</sup> Trousseau: Medical Clinics at Hotel Dieu, 1861.
- <sup>12</sup> Wolff: Virchow's Archives, vol. xx, p. 1, 1861.
- <sup>13</sup> Frerich: Leberkrankheit, vol. ii, p. 488, 1861.
- <sup>14</sup> Rayer: Bull. et mém. Méd. Soc. of Paris Hospital, vol. i, 2nd series, 1864.
- <sup>15</sup> Mangin: Thesis, 1869.
- <sup>16</sup> Senac: Treatment of Hepatic Colic, 1870.
- <sup>17</sup> Cuffer: Bull. Soc. Anat., vol. ii, p. 478, 1877.
- <sup>18</sup> Andouard: (A) Journal de Med. de l'Ouest, Nancy, 2 S. vol. iii, p. 122, 1879.
- <sup>19</sup> Massie: Thesis, Paris, 1880.
- <sup>20</sup> Lionel S. Beale: Slight Ailments, London, 1880, p. 200, Do, 1889, p. 167.
- <sup>21</sup> Walker: Brit. Med. Jr., vol. v, p. 575, 1882.
- <sup>22</sup> Mercat: Thesis, Paris, 1884.
- <sup>23</sup> Ricard, L. E.: Thesis, Paris, 1884.
- <sup>24</sup> Bond: Brit. Med. Jr., N, 12, p. 28, 1884.
- <sup>25</sup> Roth: Fertschrift Rudolf Virchow Zur Fuer Seines 70. Geburtstages Gewrdmet, Berlin, 1891.
- <sup>26</sup> Naunyn: (B) Klinik der Cholelithiasis, Leipzig, 1892.
- <sup>27</sup> Treeves: Quoted by Naunyn.
- <sup>28</sup> Thompson: (J) Edinburgh Hospital Report, vol. v, 1898.
- <sup>29</sup> Still: Transactions of Pathological Society of London, vol. iv, p. 151, 1899.
- <sup>30</sup> Riedel: Mitteilungen aus d. Grenzgebuten der Medizin und Chirurgie. Bd. 14, p. 1, 1905.
- <sup>31</sup> Riedel: Grenzgeb. d. Med. u. Chir., Bd. 19, p. 1, 1909.
- <sup>32</sup> V. Friedlander: Wiener Med. W. 58 No. 7, p. 355, 1908.



## GALL-BLADDER DISEASE IN CHILDHOOD

- <sup>32</sup> Montenbruck: Deutsche Med., vol. xxxv, No. 24, p. 1065, 1909.
- <sup>34</sup> Cahoy: Annales de la Societe Medico-Chirurgicale de Siege Freiner, 1909.
- <sup>36</sup> Wharton: Transactions Am. Surg. Assn., p. 540, 1909.
- <sup>36</sup> Stoelzner: Medizinische Klinik No. 1, p. 14, 1909.
- <sup>37</sup> Neuman: Hygiea No. 3, 1910.
- <sup>38</sup> Childs: Brit. Med. Jr., 1141, Supplement, p. 452, 1910.
- <sup>39</sup> Marton: Med. Record, February 22, 1919.
- <sup>40</sup> Eisendrath: ANNALS OF SURGERY, vol. lxvi, p. 557, 1917.
- <sup>41</sup> Khautz, A. V.: Centralbl. f. d. Grenzgeb. d. Med. u. Chir., vol. xvi, pp. 545-548, Jena, 1913.
- <sup>42</sup> Serveniere, Gourdin: Thesis, Paris, 1889.
- <sup>43</sup> Holt: Diseases of Infancy and Childhood.
- <sup>44</sup> Goddard & Still: Diseases of Children, 1921.
- <sup>45</sup> Morgagni, J. B.: De Sedibus et Causis Morborum, 1761.
- <sup>46</sup> Fauconneau Dufresne: Bile and its Diseases, 1847.
- <sup>47</sup> Luton: Biliary Calculus in Dictionary of Practical Medicine and Surgery. Date uncertain. Quoted by Serveniere.
- <sup>48</sup> Farr: Archives of Pediatrics, Sept. 1922.
- <sup>49</sup> Thudichum: Treatise on Gall-stones, 1863. (Quotes Gibson.)

## COMBINATION ILEUS, OR THE COINCIDENCE OF TWO INTESTINAL OCCLUSIONS

BY KARL SCHLAEPFER, M.D.

OF BALTIMORE, MD.

FROM THE SURGICAL CLINIC OF THE JOHNS HOPKINS UNIVERSITY AND THE JOHNS HOPKINS HOSPITAL

COMBINATION ileus has been defined by Hochenegg as the coincidence of two acute occlusions of the intestinal tract, one being primary, but becoming clinically evident only on the appearance of a secondary, superimposed occlusion. The reciprocal action of these two obstructions may cause a variation in the development of the clinical picture. The primary cause of the occlusion may be an obturation—a fecal impaction, a gall-stone, a foreign body, a new growth; or we may find a strangulation of the gut—incarceration, volvulus, band, diverticulum, in both instances a mechanical ileus. A paralyzed intestine in a case of peritonitis may also act as a primary cause (dynamic ileus). The secondary cause of the occlusion, situated in most instances oral to the primary cause, is generally an old hernia, presenting the clinical signs of incarceration; but it can also be an additional internal strangulation (hernia, band, volvulus). Clinically, a complete obstruction is present at one place; a second coexistent may only be suspected.

The first clinical impression is that of a complete occlusion at the point, where later on one cause of a combination ileus is discovered; the underlying pathological findings do not confirm the diagnosis as complete. In such cases at the time of first operation the changes at the place of apparent obstruction explained the symptoms to the satisfaction of the operator. The persistence of the ileus symptoms demonstrates that in these cases a second complete obstruction must be present distal (aboral) to the first one removed at the first operation. A second or even a third operation is necessary, until the real primary factor is eliminated. These different surgical procedures follow one another generally within a few days, exceptionally within months. This clinical entity of combination ileus has not been given the place in the literature which it deserves because of the prognostic outlook for the patient. The incidence of these cases is not so uncommon as the relatively few references in the literature might lead us to believe. The importance of accurate knowledge of the clinical picture of this special form of ileus justifies a brief review of the literature, together with a report of some personal experience; and it is hoped that this essay may arouse more interest in an important form of intestinal occlusion and be an impetus for the publication of more cases.

*Historical Notes.*—A review of Hochenegg's observation might form the starting point. Its record is impressive and gives a vivid illustration of fallibility in the diagnosis of this form of ileus. It also demonstrates the correctness of the nomenclature introduced by Hochenegg.

*Case Report.*—A man, fifty-two years of age, had suffered for years from flatulence and indigestion. Constipation became more marked. A stay in Carlsbad did not bring relief. During the summer of 1893, the patient often had attacks of colicky pains of short duration in the left upper quadrant of the abdomen. In October, 1893, following a heavy meal, patient developed the symptoms of an acute intestinal occlusion. The diagnosis of a new growth at the ileocæcal angle was made. A laparotomy was performed (Hochenegg) and a band was found constricting the lowest part of the ileum three finger-breadths above the ileocæcal junction; the colon was empty. This band was resected and an enterostomy of the dilated small intestine was found suitable. Uneventful recovery followed. The enterostomy fistula closed spontaneously.

In April, 1894 (six months later), patient had vomiting spells of one to four days duration. For intervals of two to four weeks he was without any symptoms. These symptoms of obstruction were attributed to a kinking and narrowing of the intestine by scar-tissue at the site of the former enterostomy. The persistent symptoms necessitated a resection of this part of the small gut in January, 1895. A marked hypertrophy of the wall of the transverse colon as compared with the musculature in the sigmoid flexure was noticed at this operation. No further attention was paid to this unusual fact. Patient made a rapid and uneventful recovery.

In September, 1895 (eight months after the second operation), new symptoms of acute intestinal obstruction recurred; vomiting spells were accompanied by diarrhœa. A third laparotomy was performed in February, 1896. An encircling hard new growth at the splenic flexure of the transverse colon was found. Patient died a short time after this operation.

This tumor, in its early stage, was presumably the primary cause of all these ileus-attacks. A second, accessory factor, oral to this first one, was superimposed, and predominated in the clinical picture, so that the primary cause was twice missed.

For cases in which the secondary superimposed factor is a hernia Broca, Schmidt, and Clairmont have proposed the term *pseudo-incarceration*. In these cases the hernia, present for years, becomes suddenly incarcerated as the result of the accumulation of contents due to stasis and the subsequent peristalsis and anti-peristalsis caused by an acute internal intestinal obstruction distal to the hernia. This primary cause may be a dynamic one, as in a case of peritonitis with paralysis of the intestines. Generally we encounter a mechanical obstruction (obturation). At the beginning of this acute illness the vascular disturbances are not conspicuous. An impacted fecal mass, a huge gall-stone, a foreign body, a pedunculated growth arising from the intestinal wall (an invagination), or an encircling new growth is found. In a second series of cases in which a strangulation is the primary cause of a combination ileus the vascular symptoms are predominant; in this type the clinical picture is more alarming. A band, a diverticulum, or a twisted loop of intestine may cause stasis in a hernia situated oral to this point. A second hernia (internal) of the abdominal wall or through an abnormal opening in the mesentery or the omentum may cause a strangulation. The efferent part of the whole loop in a hernia of long standing may become twisted (volvulus).

In all cases of combination ileus this primary factor becomes evident rather slowly, so that most of the clinical features of an obstruction are

concentrated on the additional, second factor (hernia) situated oral to the primary one. Any strangulation (band, volvulus) can form the secondary incident, which so often is the only one seen at the time of the first operation. Necrosis and perforation of the most damaged area of the intestine occur in the more acute cases, if the operation does not remove this obstruction. The simultaneous occurrence of a volvulus with a strangulation of a long-standing external hernia formed the subject of special papers by Knaggs and Miller. In an exhaustive article, Finsterer modified the classification previously put forth by Clairmont. Recently Block reviewed the literature of this interesting symptom-complex.

*Clinical Picture.*—In a first series of cases there is a rupture of long standing in the abdominal wall, with or without the wearing of a truss for a long period of time. In all these cases the hernial ring is quite large; in a ventral hernia the sac is often multilocular—found generally in obese persons. The onset of intestinal obstruction is sudden, with projectile vomiting, becoming feculent within a short time (two or three days); distended abdomen, which is painful all over, especially around the rupture. The hernia shows the clinical signs of incarceration; the sac is tightly filled with content, very tender on palpation, irreducible. In more advanced cases fluid can be detected in the flanks. With the diagnosis of incarcerated hernia the operation is started. In many cases recorded in the literature the surgeon, in seeking an explanation of the clinical symptoms, is apparently satisfied with the examination of the hernial content, of the afferent and efferent loops and the adjacent mesentery. A radical operation for hernia is performed. The persistent vomiting, the absence of flatus and bowel movement, together with increasing signs of peritonitis make a second exploratory laparotomy advisable. On thorough reëxamination of the abdominal viscera the primary cause of the ileus is found either in the form of an obturation (a gall-stone, coprolith, foreign body, a slowly growing benign or malignant tumor), or as a strangulation of a loop of intestine by a band, a volvulus, or an internal incarceration. This primary cause almost always lies distal to the secondary, superimposed one. In a case of volvulus the external, apparently incarcerated hernia might be situated oral to the distal loop, or form a part of it (Miller). In the presence of two hernias the second (distal) one is generally small (Clairmont). An abnormal opening in the omentum or the mesentery, or a band (Meckel's diverticulum) may be the cause of strangulation.

*Case Report.*—In a personal experience, a woman sixty-seven years old was sent to the hospital with the diagnosis of acute intestinal obstruction. For three days the typical clinical picture was present. No gas or stool was passed for three days before her admission to the hospital. Repeated enemas were ineffective. The patient was very stout, with a diffusely distended abdomen. A huge, tense para-umbilical hernia was present, very tender on pressure; and this point was the seat of the most intense pains. The obesity of the patient made an examination of the abdomen very difficult. With the diagnosis of incarcerated para-umbilical hernia the laparotomy was begun. Several distended

## COMBINATION ILEUS

coils of small intestine were found to be fixed to the internal wall of the hernial sac, but they did not show any evidence of vascular disturbances (pseudo-incarceration, Clairmont). Further examination of the abdomen was found to be necessary and the incision was enlarged. A huge gall-stone was discovered, impacted in the lower ileum. This stone was removed by enterotomy and the hernia repaired. The patient made an uneventful recovery.

The gradual dilatation of the intestine oral to the obstruction caused a gradual enlargement of the loops fixed in the ventral hernia, with consequent occurrence of more and more pronounced symptoms of incarceration at the point of rupture.

Following herniotomy in any case of incarcerated hernia, a thorough examination of the ringmarks on the gut, and of the afferent and efferent loops of intestine, together with the adjacent mesentery, may give valuable information as to the real causative factor of the obstruction, and as to whether further exploration is necessary. Thus, in a case published by Clairmont, a blue intestinal loop was pulled through the ring into the wound, proving that a circulatory disturbance was present within the abdomen and not only at the hernial orifice. A strangulation of a large convolution of small intestine in a tag of omentum fixed inside the internal ring of the hernia was the primary cause. In one of Miller's cases, when the afferent loop was inspected after the incision of the strangulating hernial ring, it was found to be bluish. A volvulus of  $360^{\circ}$  inside the abdomen had caused the secondary hernial incarceration. Miller quotes a case of huge inguinal hernia extending down to the knee, in which a volvulus inside the sac was superimposed on a second one in the abdominal cavity.

In any operation for incarcerated hernia, when the vascular disturbances in the incarcerating area do not correspond with the severity of the clinical picture, or when more marked changes point to an obstruction inside the incarcerating ring (size of loops, coloration of gut and mesentery), another (primary) cause should be suspected. Further thorough examination of the intestines in the direction of the rectum is then strictly indicated.

In this first, most common type of combination ileus, we have a cause of obstruction, externally visible (hernia), predominating in the clinical picture, associated with an internal cause, which is discovered only at the time of operation (laparotomy). The inconsistency in the findings of the pseudo-incarcerated hernia is an indication for further exploration inside the abdomen. It may be, that following the repair of the hernia the symptoms of ileus do not subside; under these circumstances a second operation is urgent, for the changes within the hernial sac are less pronounced, when there is early surgical interference. The longer operation is delayed, the greater are the vascular disturbances in the second, superimposed obstruction—the incarcerated external hernia.

In a second group of cases of combination ileus no externally visible cause of obstruction can be seen. The abdomen is distended, tender all over, with perhaps loops of intestine showing increased peristalsis. Vomiting is constant

and is accompanied by hiccough and nausea. The liver lies higher than usual; its area of dullness is diminished. In cases of longer standing the signs of peritonitis are predominant, so that the cause of this peritonitis is only recognized at the time of operation. This is well illustrated in a second personal observation.

*Case Report.*—P. W., white man, thirty-three years old, was admitted to the hospital on June 12, 1916, with acute peritonitis. Family history, unimportant. Past history, always in good health up to the present illness. Patient has had a left inguinal hernia since he was twelve years old, on account of which he was exempted from military service. Present illness: June 10, 1916, patient was suddenly seized with intense pains in the abdomen, which lasted for a short time. They gradually decreased in intensity, with exacerbations at intervals of some hours. He had several attacks of vomiting. Next morning (June 11th) the pains and vomiting still persisted. A doctor was summoned, who made a diagnosis of acute gastro-enteritis. He ordered rest in bed with local application of hot compresses, to be changed very frequently. On June 12th patient localized the pains in the region of the bladder and complained that he was troubled with a desire to urinate frequently. He passed water at short intervals. No vomiting, but there was eructation. Later the doctor remembered to have felt a slight resistance on the left side just above Poupart's ligament next to the bladder. Catheterization performed by the family physician revealed an empty bladder. There was no flatulence or bowel movement for two days. Last defecation was one hour before the onset of the present illness.

*General Examination.*—Temperature, 38.3° C.; pulse 110. Patient was lying in a passive position in bed; face flushed, conjunctivæ injected, no jaundice of the scleræ; tongue, white, coated, dry, no enlarged tonsils; neck normal. Examination of the chest was negative; urine, no albumen, no sugar.

*Local Examination.*—Abdomen distended in the lower half, flat in the upper half, with muscular rigidity all over, more pronounced in the lower part. On percussion there was tympanitic sound everywhere except in the flanks and above the symphysis and Poupart's ligament. The liver dullness was not increased; the lower border lay above the costal margin. In the left scrotal sac was an irregularly shaped mass the size of a lead pencil, running with the cord to the external inguinal ring, and passing into the inguinal canal. It could not be reduced; it was not tender on pressure; no change was noticed when patient coughed. Rectal examination was negative.

*Diagnosis.*—Appendicitis, acute; peritonitis, circumscribed; left inguinal hernia, indirect, irreducible.

*Operation.*—Ether. A McBurney incision was made. When the abdominal cavity was opened a bluish, distended intestine was seen. Blood-tinged fluid was present. This was indicative of intestinal obstruction. The incision was then closed temporarily. A midline incision was made, large enough to give a good exposure. The following condition, shown in the accompanying Fig. 1, was found: A loop of small intestine was strangulated in a slit of the greater omentum, which extended down into the left inguinal canal. With its medial border, this tag of omentum was fixed inside the left internal inguinal ring. The afferent loop of intestine was distended, the efferent loop collapsed distal to the incarceration. The loop was bluish, the mesentery also cyanotic and oedematous. In order to liberate the intestinal loop the omentum was cut on one side after clamps had been applied on each side. But a portion of this 40 cm. long loop was caught within a properitoneal hernia on the left inguinal side. The

distended loop produced a protrusion of the peritoneum into the abdominal cavity (Fig. 1). As an incarceration was present a reduction was impossible. Following the herniotomy this loop became free. There was a deep impression in the gut at the point of strangulation, and the serosa was dull. The peristaltic waves did not pass over this area. The whole loop was wrapped up in hot saline compresses. The greater omentum was followed to the left internal inguinal ring, where a medial part was found to be adherent to the anterior abdominal wall. This was cut off. The lateral portion extended down into

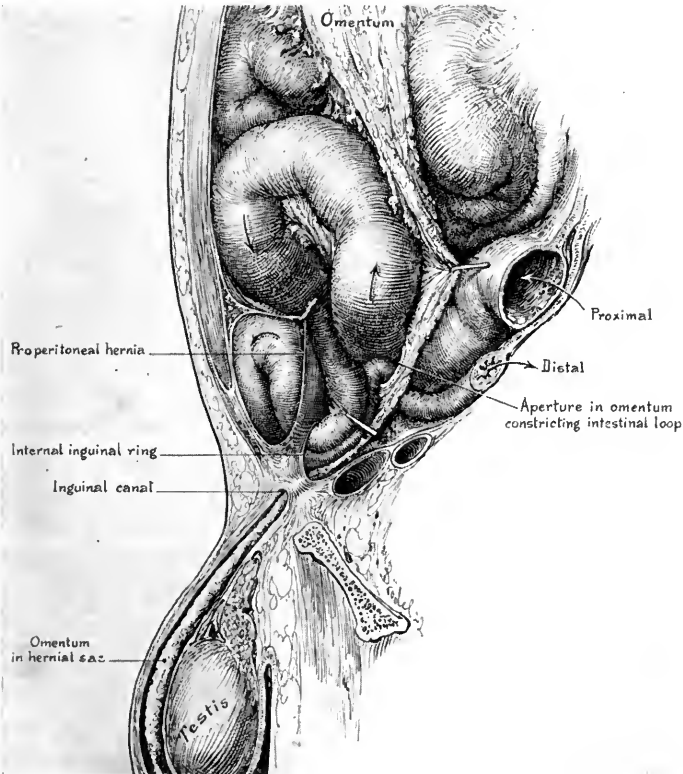


FIG. 1.—Showing the protrusion into the abdominal cavity, caused by the underlying distended loop of intestine.

an inguinal hernia. By using considerable force it was liberated. In order to shorten the operation the opening in the internal ring was closed from the inside without removal of the sac. The loop remained blue, and there was no evidence of peristalsis. It was decided, that resection of the whole loop was necessary, and a side-to-side anastomosis was performed followed by toilet of the abdominal cavity with removal of all bloody fluid. Closure of the abdominal incisions in four rows and bandage completed the procedure.

Patient stood the operation well.

*Post-operative Course.*—Patient made an uneventful recovery and was discharged twenty-six days after the operation without any abdominal discomfort. One year later patient was seen in perfect health.

Schnitzler reported an analogous case with the coincidence of a long-standing incarcerated right femoral hernia in a woman sixty-eight years old,

in which at the time of the first operation only the incarceration of the liernia was relieved. The persistent symptoms of ileus necessitated a second laparotomy. A loop, partly incarcerated before the first operation in the hernia, was found constricted in an opening of the greater omentum. This case, although belonging to our first group, is more instructive when presented together with our personal observation of the second group.

In our second personal case the slit in the greater omentum was large enough to allow the passage of a normal distended small intestinal loop. This opening in the omentum may be either a congenital one as present also in the mesentery, or the end-result of a trauma following a sudden fall, with injury (tearing) of the omentum at the site of the slit. This mechanical agent may act either from the outside through the abdominal wall, or it may be the result of a sudden stroke of a filled intestinal loop against the omentum, attached on one side to the stomach, on the other to the internal inguinal ring. Even without this special predisposing factor formation of an opening may occur. The properitoneal hernia was probably present for a long time. Generally it is accompanied, as in our case, by a congenital inguinal hernia (Krönlein). This secondary sacculation is gradually formed by repeated reposition en bloc of an inguinal hernia. The constant pushing of the abdominal content (omentum) within the inguinal canal against a truss may form an additional factor. In our case the patient asserted, that on lifting or straining the left hernia became larger. For a long time he wore a truss. In our case, as in Schnitzler's, the opening in the greater omentum was not in itself responsible for the occlusion. The occlusion resulted from a part of the same loop of small intestine being caught in the properitoneal sacculation (in Schnitzler's observation: femoral), this factor acting simultaneously with the kinking of this loop in the slit of the omentum. The contents, accumulating in the afferent loop, first caused the incarceration of the properitoneal hernia. The same vicious circle distended the afferent loop in the opening of the omentum more and more and constricted the efferent loop and mesentery: the combination ileus became a fact. In Schnitzler's case Clairmont thinks that the internal strangulation in the omental slit was the primary factor, and the incarceration of the hernia, resulting from an increased stasis of the bowel movement, with the consequent increase in peristalsis and antiperistalsis making the hernia irreducible, a secondary one. Finsterer assumes that the incarceration of the hernia was the primary factor, with a secondary internal strangulation. Undoubtedly we are confronted in these two cases with the alternating ill effects of two causes of the hernia, which bring about a relative fixation of the loop beyond the opening in the omentum. Increased peristalsis and antiperistalsis are powerless to counteract this condition. In this way is caused the incarceration of the primarily irreducible hernia simultaneously with an internal strangulation of the whole loop of intestine within the slit of the omentum.



In our second group of combination ileus both causes escape our physical examination previous to operation. The clinical symptoms point to an intestinal occlusion. Close examination of the size, colorations, and condition of the gut in different regions of the abdomen at the time of the exploratory laparotomy clears up the underlying pathological condition.

*Diagnosis.*—In the first group mentioned, where we encounter a combination of an external rupture in the abdominal wall, and signs of incarceration (pseudo-incarceration) associated with a secondary occlusion within the abdominal cavity, the true diagnosis can only be made at the time of operation by a thorough examination of the intestine beyond the ring of probable incarceration combined with painstaking but thoughtful examination of the size and vascular conditions (cyanosis) of one or both loops inside the hernial ring. In cases which come under observation early, the severity of the symptoms might not be explained on the basis of the long-standing, large hernia with vague signs of incarceration, so that a second factor of obstruction has to be sought for. In cases seen when the clinical symptoms are more advanced and the signs of peritonitis very pronounced, it is rather difficult to make such a differentiation even in our first group. This is particularly true for men accustomed to explain the symptoms by one and not by several causes. In any case of incarcerated hernia a thorough examination is indicated of the afferent and efferent loops (size and coloration), together with the changes at the point of incarceration and the adjacent mesentery. A blue, dilated afferent loop with or without an efferent loop similarly affected points to a combination ileus, the primary cause being removed only by an exploratory laparotomy.

In our second group of cases the diagnosis of combination ileus can only be made at the time of operation by careful examination of the size and vascular condition of the intestine adjacent to the site of the detected obstruction and by following them thence in both directions (orally and distally). As demonstrated in Hochenegg's case, it is often very difficult to exclude a second obstruction, if at the exploratory laparotomy an inspection and palpation of the whole intestinal tract is omitted.

Since in every case of intestinal obstruction the accumulation of gas in the intestine is different, varying with the location of the obstruction (high, low), Kloiber advises an X-ray examination (plate) of the abdomen. From a series of such pictures obtained from different cases of intestinal obstruction verified subsequently by laparotomy, Kloiber set forth certain laws about the location of the greatest amount of gas in the presence of the obstruction at different levels of the intestinal tract. Due to the fact, that this method is very unreliable and that in all these cases immediate operation is urgent, this examination means a loss of time, with greater, avoidable shock to the patient, and does not shorten in any way the operation after one source of obstruction has been exposed. It is not justifiable to postpone operation for a diagnostic procedure which does not add anything to a thorough local examination.

*Therapy.*—Hernio-laparotomy for the cases of the first group, laparotomy for cases of the second group is the therapy of choice. In a previous article on gall-stone ileus I advised laparotomy under splanchnic- and block-infiltration anæsthesia of the abdominal wall as the best technic. This holds true for a man experienced in the technic of this form of anæsthesia. A much better recovery takes place following this operation in these cases, generally in poor condition. For the average surgeon general anæsthesia has to be employed. The most suitable method of procedure in each case depends on the pathology of the lesion, and on the vascular changes which have taken place in the tissue involved in the obstruction or strangulation from the onset up to the exposure at the operation.

*Prognosis.*—The earlier the case comes to operation, the less are the pathological changes in the intestine at the site of occlusion, the less also is the alteration of the general condition (dehydration, toxæmia). By using local anæsthesia in form of a combined splanchnic abdominal wall local anæsthesia the chances for a quick and uneventful recovery are much improved. Clairmont, in his very exhaustive statistics, found a mortality of 70 per cent. (1909). This was particularly due to the fact that an erroneous etiology was the guidance at the first operation in many cases reported in the literature. The real cause persisted and necessitated a second surgical interference after hours, and even days. In this way the final cure was postponed. In the meantime the patient lost more of his vital resistance.

*Summary.*—Combination ileus is a clinical entity, which may be suspected in any case of incarcerated hernia (pseudo-incarceration), where the history of the present illness, together with the findings of the local examination, show a marked discrepancy with a clinical picture of a complete acute intestinal occlusion of longer standing; and particularly where an unusual picture is discovered during the operation following a herniotomy at the ring of incarceration, the size and vascular condition of the afferent and efferent loops of intestine and adjacent mesentery.

Another primary cause of obstruction inside the abdomen may be suspected. Vascular disturbances, dilatation of the afferent and efferent loops are points of significance in these conditions. A laparotomy with thorough examination of the gut orally and aborally will expose the primary factor in the occlusion. This is generally a mechanical occlusion, either an obturation (gall-stone, coprolith, new growth), or a strangulation (hernia, band, volvulus, diverticulum). In cases of peritonitis with paralysis of the intestines we have to consider a dynamic ileus as primary factor.

In a second group of cases both causes are located inside the abdomen. With the presumptive diagnosis of acute intestinal obstruction, the laparotomy is indicated. After having removed one cause of obstruction a thorough and thoughtful examination and palpation has to be made to exclude the presence of a second, hidden, primary cause or a second superimposed cause of acute occlusion. Every case of combination ileus needs prompt surgical

interference. The earlier the operation is performed the better is the prognosis. The great mortality in these cases is due to the fact that at the time of the first operation (herniotomy, laparotomy) only one factor in the obstruction is removed and a second operation, with the patient in much weaker condition, is necessitated by the persistence of the symptoms of an acute intestinal obstruction. In observing the directions given above, this danger should be greatly diminished.

## BIBLIOGRAPHY

- Bircher, E.: Ueber 2 bemerkenswerte Fälle v. Ileus. Arch. f. klin. Chir. Berl., 1911, Bd. 95, S. 8.
- Block, W.: Ueber mehrsitzigen Darmverschluss und Scheineinklemmung v. Brüchen. Ein Beitrag zu den seltenen Ileusformen. Dtsche Zeitschrift f. Chir., 1922, Bd. 169, S. 329.
- Broca, P.: De l'étranglement dans les hernies abdominales et des affections qui peuvent le simuler. V. Masson, Paris, 2ième édition. 1857 (cit. from Clairmont).
- Carless, A.: A Case of Combined External and Internal Strangulation. Lancet, 1900, vol. i.; V. 12., p. 1357.
- Clairmont, P.: Die Scheineinklemmung von Brüchen. Arch. f. klin. Chir., 1909, Bd. 88, S. 631.
- Curl, H. C.: Combined Volvulus and Hernia Through a Recent Mesentery Slit. ANNALS OF SURGERY, 1905, vol. xlii, p. 207.
- Ehler, F.: Ueber einige Fälle von interstitiellen Leistenbrüchen. Arch. f. klin. Chir., 1911, Bd. 96, S. 1012.
- Finsterer, H.: Ueber doppelten Darmverschluss (Combinationileus). Beiträge z. klin. Chir., 1912, Bd. 81, S. 361.
- Hochenegg, J.: Ueber eine neue typische Form des akuten Darmverschlusses. (Combinationileus) Wien. klin. Wochenschr., 1897, No. 51, S. 1117.
- Hoffmann, M.: Ein seltener Fall von zweiseitigem Strangulationsileus. Wien. klin. Wochenschr., 1903, S. 1135.
- Kaiser, O.: Volvulus coeci mit Inkarceration in einer Leistenhernie (gleichzeitige Einklemmung eines Ileumabschnittes mit intra-abdominellem Volvulus der zu diesem zuführenden Ileumschlinge). Dtsche Zeitschr. f. Chir., 1900, Bd. 55, S. 443.
- Klauber, O.: Abnorme Mesenterialverhältnisse inkarzierter Hernien. Ein Fall v. Kombinationileus. Münchn. med. Woch., 1907, Bd. 54, S. 1986-89.
- Kloiber, H.: Die Roentgendiagnose des Ileus ohne Kontrastmittel. Arch. f. klin. Chir., 1918, Bd. 112, S. 513.
- Knaggs, R. L.: Volvulus in Association with Hernia. ANNALS OF SURGERY, 1900, vol. xxxi, p. 405.
- Knaggs, R. L.: A Case of Strangulated Femoral Hernia in which Gangrene was Precipitated by an Intra-abdominal Volvulus. Lancet, 1900, vol. i, p. 1726.
- Krönlein, R. U.: Herniologische Betrachtungen a. d. v. Langenbeck'schen Klinik. Arch. f. klin. Chir. Berl., 1876, Bd. vol. xix, S. 408.
- Krönlein, R. U.: Weitere Mitteilungen üb. d. Hernia inguino-properitonealis. Arch. f. klin. Chir. Berl., 1880, Bd. vol. xxv, S. 548.
- Miller, R. T., On the Coincidence of Volvulus and Real or Simulated Strangulated Hernia. ANNALS OF SURGERY, 1911, vol. liii, p. 232.
- Prutz, W.: Die angeborenen und (nicht operativ) erworbenen Lücken und Spalten im Mesenterium und ihre Bedeutung als Ursache d. Darmverschlusses. Dtsche Zeitschr. f. Chir., 1907, Bd. 86, S. 399.
- Schlaepfer, Karl: Ueber einen durch Operation geheilten Fall von Gallensteinileus. Corresp.-bl. f. Schweizerärzte, 1914, No. 38, S. 1203-1210.

## KARL SCHLAEPFER

- Schlaepfer, Karl: Ueber einen weitem Fall von Gallensteinileus. Bruns' Beiträge z. klin. Chir., 1921, Bd. 122, S. 122.
- Schmidt, B.: Die Unterleibsbrüche. Deutsche Chirurgie, Lief. 47, Stuttg., 1896, S. 196.
- Schnitzler, J.: Ein Fall von totaler inkarzeration nebst Bemerkungen üb. d. Mechanism. d. Darmwandeinklemmung Wien. klin. Wochensch., 1891, S. 545.
- Wilms, M.: Schlappe Darneinklemmung bei Hernien. Bruns Beiträge z. klin. Chir., 1906, Bd. 50, S. 465.
- Wilms, M.: Der Ileus. Deutsche Chirurgie, Bd. 46 C., 1906, S. 407.
- Wilms, M.: Ileus in Bruns-Garré-Küttner: Handb. d. prakt. Chirurgie, Stuttgart, 1913, Bd. iii, S. 375.

# TRANSPOSITION OF THE RECTUS MUSCLE AND THE UTILIZATION OF THE EXTERNAL OBLIQUE APONEUROSIS IN THE RADICAL CURE OF INGUINAL HERNIA

By WINFIELD SCOTT SCHLEY, M.D.

OF NEW YORK, N. Y.

At this date, 1922, some thirty-five years after the publication of Bassini's first communication, a continued discussion of the subject of the radical cure of inguinal hernia is sufficient evidence that operative technic is ever changing to meet the faults or deficiencies of earlier procedures. Our surgical art is ever advancing and the more rapidly with a better recording and following

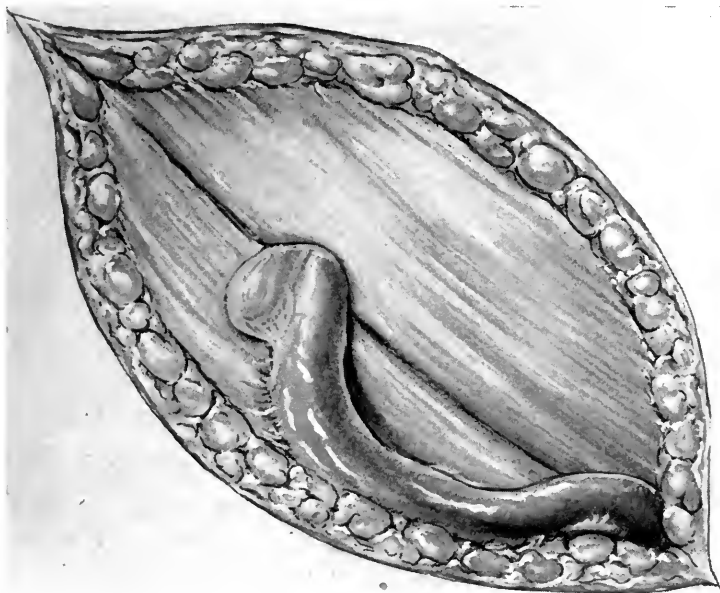


FIG. 1.—Appearance of the three small recurrences along the cord through the internal ring.

of operative cases and a freer interchange of ideas. The literature upon inguinal hernia is not voluminous. The operation advocated by Bassini in 1887 satisfied operators for nearly twenty years, as cases were rarely followed and the number of recurrences was entirely unappreciated.

The Bassini operation, founded upon correct, sound, anatomical and physiological principles was sufficient to cure the majority of cases of inguinal hernia and still is. There is, however, a goodly percentage of cases where because of the patient's anatomical deficiencies of musculature it is insufficient alone to do so. This was appreciated by a few at the close of the last century. Bloodgood, Andrews, Coley, Blake, and later Judd and Downes, published modifications and additions.

In 1913,<sup>1</sup> I traced the history from Bassinis' publication up to that year and again spoke for the transposition of the rectus muscle and again in 1918,<sup>2</sup> during the war, made a further plea to fit the operation to the case and not force every case of hernia to fit a classic operation however good that might be for the average case. In 1920<sup>3</sup> Hogue, Stettin and myself again advocated additional use of the external oblique aponeurosis as one more layer to reinforce the old classic procedure. This could be used with or without a transposition of the rectus as well, thus giving three layers of

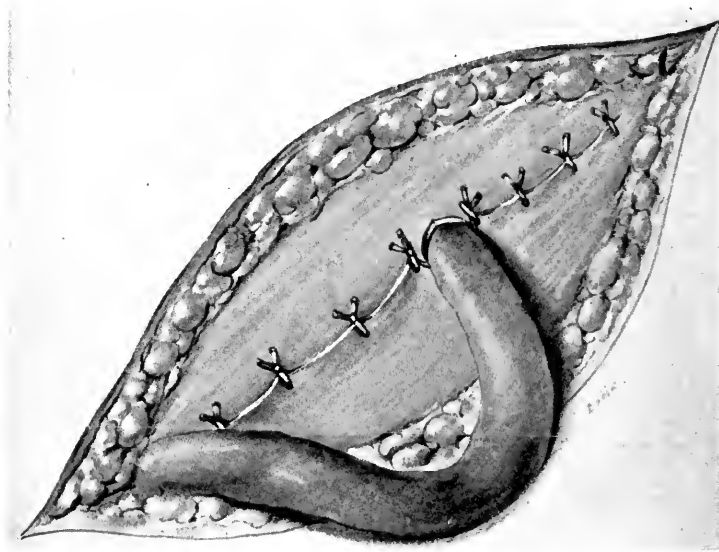


FIG. 2.—Old method which appeared to leave a weakness at emergence of the cord.

tissue in those bad direct herniæ as well as in the simpler indirect variety where the oblique muscles were weak and inadequate for a strong repair. The anatomical resources of this region are fortunately considerable and are of vast importance when well used.

The late war greatly stimulated interest in this class of case, enormously increased the number of operated cases, and made it of paramount importance that the men operated should have the greatest fortification possible of this inguinal region and the greatest care used in selecting the type of operation in each case. From the additional experience of the last decade I believe that the problem of the cure of direct hernia is solved to within 3 or 4 per cent. in those cases whose physical condition will permit of operation. The purpose of this paper is to give the results of the cases of rectus transposition and aponeurotic overlap done the last three years which have been followed,

<sup>1</sup> ANNALS OF SURGERY, vol. lviii, 1913.

<sup>2</sup> ANNALS OF SURGERY, vol. lxvii, 1918.

<sup>3</sup> ANNALS OF SURGERY, vol. lxxi, 1920.

as well as to call attention to a source of weakness in the procedure of overlapping the aponeurosis that has appeared in three cases.

Utilizing in all direct hernias the imbrication or overlapping of the external oblique aponeurosis and nearly always with a transposition of the rectus as well, there has been no recurrence as a direct hernia in these cases during the last three years.

The imbrication or overlap of the oblique aponeurosis has been used practically as a routine addition to the hernia operation for the last three

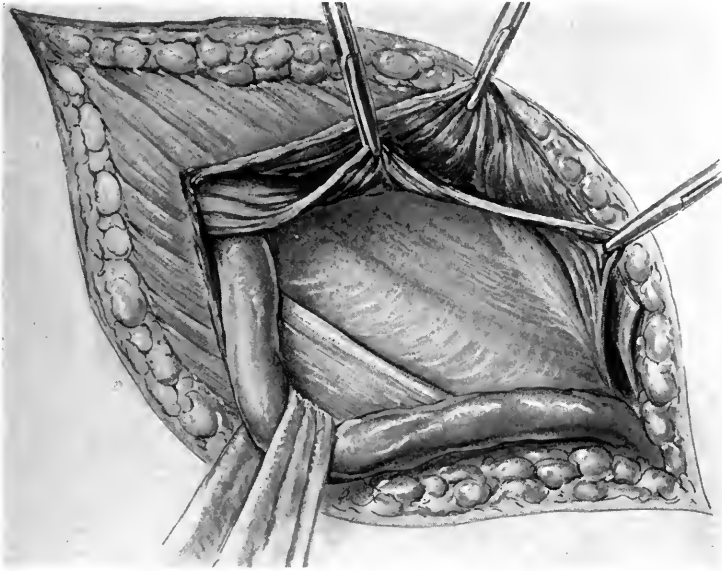


FIG. 3.—Exposure of rectus by wide retraction of oblique muscles.

years in indirect as well as direct cases, usually excepting hernias in women and children. The last two years I have modified the method with advantage, having had three small indirect recurrences at the site of the internal ring coming out along the cord (Fig. 1). They could be repaired easily under local anæsthesia and have not recurred to date. The illustrations show the character of this recurrence and the present modification. Even as such they were not a great price to pay for the cure of large direct hernias. It was of great interest to note in those reoperated cases that the rectus muscle was found where it had been sutured. It had not separated from Poupart's ligament.

To find material for the protection of the frequently weak inner half of Hesselbachs' triangle and through which direct herniæ come is not very difficult, but we should not lose sight of the internal ring with its weakness at the exit of the cord. It apparently is not alone necessary to suture muscle as closely about the cord as possible without obstructing its circulation, but one must oppose another structure over this exit of the cord to act as additional barrier here and to seal the opening by agglutination. The aponeurotic

overlap recommended in 1920 was achieved by slitting both halves of the external oblique aponeurosis opposite the cord (Fig. 2) to allow free overlap. This method most satisfactorily strengthened the overlap and proved most satisfactory in curing direct hernias and fortifying tissues of deficient musculature in indirect hernias, but it left the internal ring too unprotected. The method of bringing the cord up and lapping the lower or outer half over the opening seems to have overcome this and allowed a maximum of protec-

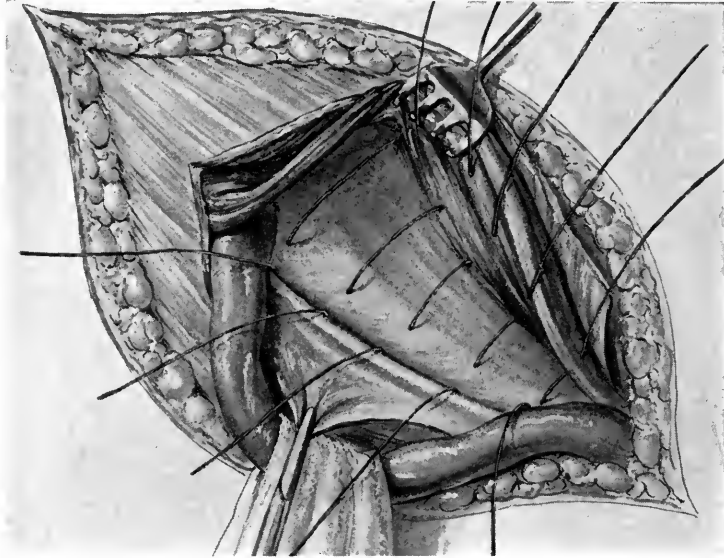


FIG. 4.—Sutures passed well through the reflected or shelving edge of Poupart's ligament. Rectus sheath widely opened.

tive strength for both areas. There have been no further recurrences since doing this.

It would seem that in every operation for the cure of inguinal hernia it is of the greatest importance that the cord be transplanted and not brought out under the muscle or aponeurosis at the lower end of the wound and that the inguinal canal be completely obliterated to the pubic spine.

The utmost agglutination and broadest coaptation of muscle and aponeurosis to Poupart's ligament and its shelving reflection and the muscles and aponeurosis to each other is essential in every case and especially in this inner half when we find deficient oblique muscle and weak transversalis fascia. The technic of rectus transposition is not difficult, yet from published descriptions where the sheath has been opened but a short distance and two or three, or possibly four, sutures were used to bring the muscle to Poupart's ligament, it can be understood why so many men feel that the rectus cannot be made to stay in this relation. It has seemed to me that the internal oblique and transversalis muscles must be retracted well upward and inward and the thin sheath of the rectus (Fig. 3) opened from behind for fully five inches.



The muscle must be separated from its sheath anteriorly and posteriorly by the finger throughout its whole lower extent. Under proper anæsthesia it is amazing how easily it is brought down without tension and sutured by five stitches to the deepest shelving part of Poupart's ligament, including a small part of that structure itself (Fig. 4). It is thus almost below the ligament proper. The lowest suture is taken at the spine, closing completely the apex of Hesselbach's triangle, and the uppermost suture taken at the internal ring close to the cord exit. I do not believe that in any other way will the muscle stay as thoroughly in place. The alignment of its fibres is not so greatly changed (Fig. 5) and the newer attachments to the next layer superimposed, the

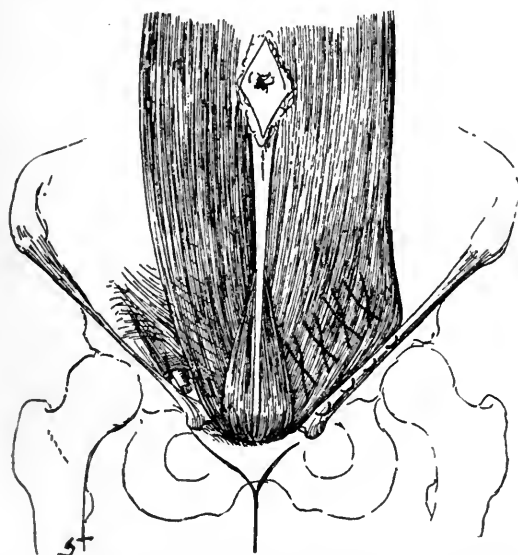


FIG. 5.—Deviation of fibres of rectus (after Bloodgood), after suture to Poupart's ligament.

oblique muscle and transversalis, materially help to maintain it in its new position. This muscular layer (the Bassini procedure) is sutured to Poupart's proper (Fig. 6). There is one more suture that I have used to help maintain the rectus and this is taken through the obliques, above and internal to the cord to the rectus, making a total of six interrupted stitches. The strain is thus distributed and equalized. The aponeurotic overlap is then done, the internal half of the external oblique aponeurosis sutured to the upper part of Poupart's ligament and the outer half lapped over

this, leaving the cord superficially beneath skin and adipose tissue where it seems to cause no discomfort (Fig. 7). This overlap of the halves of the divided aponeurosis of the external oblique muscle adds a very real strength in the amalgamation of the various layers which we are able to interpose between the peritoneum and weak transversalis fascia and the outer world. As a last precaution these patients have their knees well elevated before they return to consciousness and the head and trunk moderately flexed as well. This position for the first week or ten days is of considerable importance in relaxing muscle tension. The repair in these more serious cases done in this way is not difficult and I believe at present can only be done effectively in this way and give this procedure the chance for more general favor which I am convinced is its due.

Differences in reparative power, inequalities in even the best suture material and inequalities of its absorptive time by individuals as well as the patient's care of himself after operation, all play a part in hernial recurrences where clean primary union has been secured. The inclusion of the weak

cremaster muscle in the repair of inguinal herniations has, I believe, contributed to recurrence, particularly in the direct area. The insufficient cleaning of Poupart's ligament of connective tissue that may prevent intimate contact probably is of etiological importance. Adequate relaxation in bed after operations of this sort for eighteen days is desirable.

The various procedures utilizing the rectus muscle and the aponeurosis of the external oblique muscle have a definite usefulness in a number of cases of indirect as well as direct hernia, with muscular deficiencies where the operation

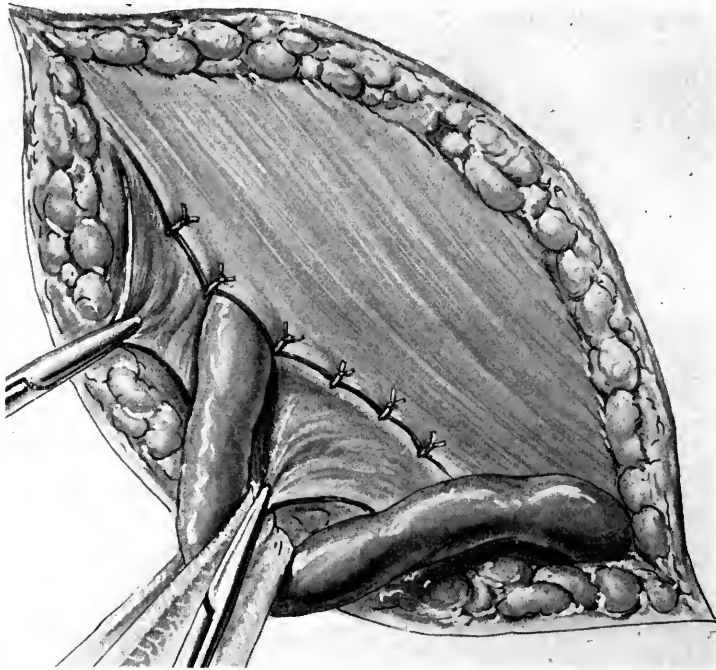


FIG. 6.—Inner half of external oblique aponeurosis sutured to Poupart's over rectus and over the internal oblique and transversalis.

is made to fit the condition and not the condition made to fit a fixed operative procedure.

Of the cases of inguinal hernia which have come to me for operation the last four years and a half, a rectus transposition was done eighty-five times, an overlap of the external oblique aponeurosis ninety-seven times, a combined rectus transposition and aponeurotic overlap in forty-eight and the Bassini repair with aponeurotic overlap in forty-nine. All other cases were operated using the straight Bassini procedure.

During the years 1917 and 1918, the majority of hernia cases were in recruits or service men very few of whom could be followed. I believe that notwithstanding the operative care and selection of a strong type of repair the percentage of recurrence in these cases would be found above normal,

## TRANSPOSITION OF RECTUS MUSCLE IN HERNIOTOMY

as the men were enthusiastic, difficult to restrain and took poor post-operative care of themselves. In the last four years eighty-seven of these modified repairs were traced and observed in the follow-up clinic. Of twenty-two direct hernias, operated with rectus transposition and overlap of aponeurosis, none have recurred. Two recurrences followed in cases of indirect hernia operated by Bassini muscle repair with aponeurotic overlap. Both cases had extensive post-operative wound infection. As mentioned above, in three direct hernias that have remained cured of their large direct ruptures, there appeared within the first year a small protrusion along the cord (Fig. 1)

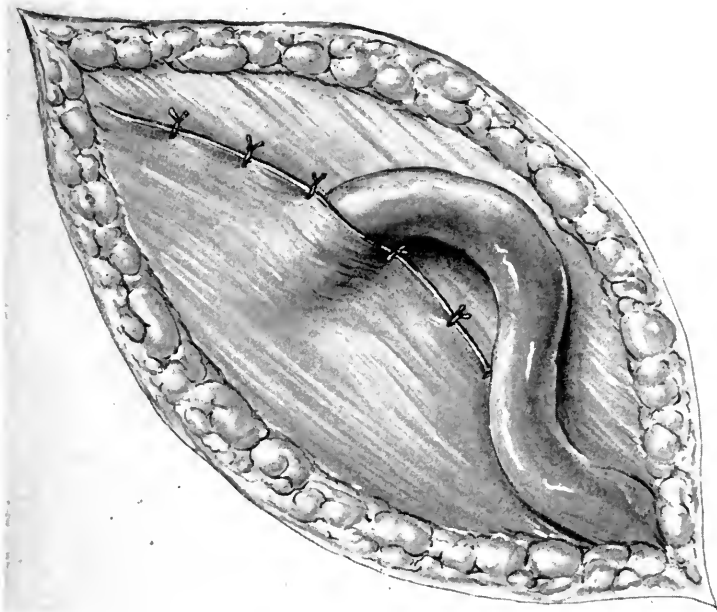


FIG. 7.—Outer half of the external oblique aponeurosis lapped over the inner and exit of cord, closing the area of emergence opposite the internal ring more completely.

coming out through the internal ring. These were easily repaired and at reoperation it could be clearly demonstrated that the rectus muscle had not separated from Poupart's ligament. Two of these men were laborers and had resumed heavy work within two weeks after leaving the hospital. It led as mentioned to a change two years ago in the method of imbrication of the external oblique aponeurosis at the exit of the cord opposite the internal ring. Since this time there have been no other recurrences in these cases to date. But fifteen cases were in women and in only three were modifications of the usual procedure done. There have been no recurrences in any. Only twelve cases were in children and there was but one modification which has remained well over two years. Two were not seen and the rest have remained well.

## ANTERIOR DISLOCATION AT THE ELBOW JOINT

By FREDERICK J. TEES, M.D.

OF MONTREAL, CANADA

FROM THE FRACTURE DEPARTMENT, MONTREAL GENERAL HOSPITAL

IN view of the comparative frequency of posterior dislocations of the elbow it is rather remarkable that anterior dislocations of that joint should be among the rarest of injuries.

How commonly elbow dislocations occur may be judged from Krönlein's series of 400 recent traumatic dislocations, where 109, or 27.2 per cent., involved the elbow; and yet if in all the cases of anterior dislocation of this



FIG. 1.—X-ray showing anterior dislocation of elbow, with detachment of internal epicondyle.

joint thus far reported we exclude those associated with fracture of the olecranon—which, by common consent, should not be regarded primarily as dislocations—the total number does not exceed twenty.

The injury is mentioned by Hippocrates as the most painful of all dislocations, and as fatal in a few days, but no authentic case seems to have been described until within the past century. In fact, Sir Astley Cooper (1768–1841) denied the possibility of its occurrence.

Streubel in 1850 collected a few cases and discussed the mechanics of their production, describing his attempts to reproduce the deformity on the cadaver.

## ANTERIOR DISLOCATION AT THE ELBOW JOINT

The most complete review of this injury is that of Stimson, who records a list of cases observed up to 1912. He accepts twenty-four as authentic, of which seven were associated with fracture of the olecranon and hence hardly to be included. Of these all but two were reported prior to 1900.

I have been able to find but three subsequent cases in the literature; one by Von Walzel, one by Winslow, and a third by Sir Robert Jones, the latter case complicated by olecranon fracture.

These, together with the following case from the fracture clinic of the Montreal General Hospital, bring the number, excluding the eight cases with detachment of the olecranon, to a total of twenty.

*Report of Case.*—C. G., aged twelve, No. 5189, 1920, was admitted to the Montreal General Hospital on November 16, 1920. While in a laundry on the day of admission, his curiosity led him to try the effect of feeding his right hand between the revolving rollers of a wringing machine, with the result that his arm was securely caught. As he attempted to extricate himself from the machine, his elbow was squeezed by the rollers, and the olecranon forced downwards and forwards over the end of the humerus, bringing about a complete anterior dislocation of both radius and ulna.

On admission the arm was swollen and ecchy-mosed for a hand's breadth

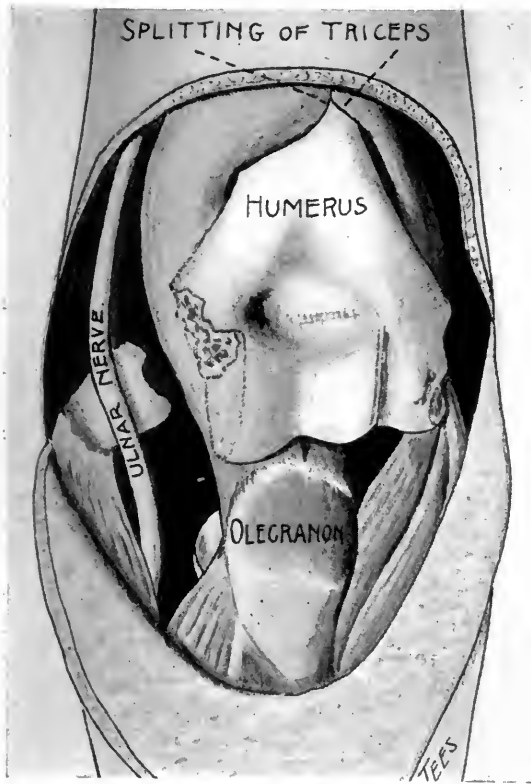


FIG. 2.—Right elbow from behind. Anterior dislocation of elbow with button-holing of lower end of humerus through triceps tendon.

above and below the elbow. The lower end of the humerus, especially the external condyle, could be palpated, but there was a complete absence of anything to correspond with olecranon, and the internal condyle was not palpable. On measurement the forearm was appreciably lengthened. The elbow was most comfortable when held at an angle of 135 degrees. Movements at the joint were flail-like; quite free in flexion and to the sides, but limited to 150 degrees in extension.

The skiagram, by Dr. W. A. Wilkins (Fig. 1), revealed a complete forward dislocation of both radius and ulna, with a detachment of the internal epicondyle.

One was led to expect from the experience of various authors that reduction would be a simple matter, but a protracted attempt under anæsthesia was completely unsuccessful.

On November 26th, open reduction revealed the reasons for the failure. A horseshoe flap was turned down, uncovering the bare lower end of the humerus, which was projecting backwards through a button-hole opening in the triceps tendon (Fig. 2). The tendon had been split longitudinally; the main portion, having been carried between the humerus and the detached internal epicondyle, was lying in front of the trochlear surface of the humerus, the remainder passing forward around the outer side of the bone. The ligaments had been completely torn away. The ulnar nerve had been displaced inwards with the detached epicondyle: it was dissected out with care and found to be uninjured. Even with the parts completely exposed, reduction was difficult and could never have been accomplished by manipulation alone.

After reduction the loose fragment was sutured in position, the wound closed, and the arm fixed at right angles in plaster. The wound healed by primary union. No manipulation was undertaken for two weeks, and then most gently and sparingly. In this we followed the teaching of Mennell and others that the elbow-joint must be excepted from the rule calling for early mobilization after joint injuries. Nevertheless a lot of callus formed about the lower end of the humerus and when the patient left the hospital on February 11, 1921, movement in the joint was considerably limited, ranging from 80 to 125 degrees. Efforts to have him report his subsequent progress have been unavailing.

*Comment.*—After scrutiny of a series of X-rays of the elbow-joint in children, such as have been published in a recent article of Cohn on the developing elbow, one is prepared, from the apparent lack of security in attachment of the main lower epiphysis of the humerus, to expect frequent epiphyseal separation as a result of injury; but the relative insignificance of the olecranon is equally striking, which, it might be thought, would render anterior dislocations of common occurrence. Yet but three of thirteen cases of Stimson's series in which the age is stated occurred in children under fourteen years of age.

The explanation of this extreme rarity seems to lie in the strength of the ligaments rather than in the contour of the bones. The ligaments, even in children, must be sufficiently strong to resist a dislocating force from above and behind (such as occurs in falls on the flexed elbow), and hence, as a result of this form of trauma, there is ordinarily produced not a dislocation but a separated epiphysis or a supracondylar fracture.

#### BIBLIOGRAPHY

- Krönin: Deutsche Chirurgie, Lief 26, p. 5.  
 Streubel: Prager Vierteljahrshrift, 1850, vol. ii, p. 37.  
 Stimson: Fractures and Dislocations, Lee & Febiger, 1912, p. 705.  
 Von Walzel: Archiv f. klin. Chir., 1914, vol. cv, p. 240.  
 Winslow, R.: Trans. So. Surg. & Gym. Assn., 1912, Phila., 1913, vol. xxv, p. 75.  
 Jones: Quoted in Thomson & Miles, Manual of Surgery, Oxford Medical Publications, 1913. V. vol. i, p. 525.  
 Mennell: Orthopædic Surgery of Injuries, Oxford University Press, 1921, vol. ii, p. 542.  
 Cohn: Archiv. of Surgery, vol. ii, No. 3, May, 1921, p. 455.

## CARDIOSPASM IN THE AGED

By J. H. ZAAIJER, M.D.

OF LEIDEN, HOLLAND

PROFESSOR OF SURGERY IN THE UNIVERSITY OF LEIDEN

CARDIOSPASM is as a rule most frequently encountered in youth or middle age. When, however, elderly people begin to show symptoms of interference with deglutition, apparently due to some narrowing of the œsophagus, one is more inclined to consider the condition carcinomatous and without making an exhaustive examination allow these patients to gradually starve, appreciating the fact that radical therapy is of so little effect and that a gastrostomy merely prolongs for a short time a life of suffering.

That this danger of not making a thorough examination is a very pertinent one is illustrated in the recitation of the following two cases:

CASE I.—Single, age sixty-one, male, November 7, 1921. Previous to examination had been seen by several competent physicians by whom a diagnosis of carcinoma œsophagi had been made. His first complaint had begun in May, 1918, when he noticed that on bending forward saliva or some secretion flowed back into his mouth. Two months later it was noted that the food passed into the stomach with difficulty, liquids as well as solids, and was in a large measure regurgitated. This occurred also at night. Intensity of his complaint steadily increased.

On examination it was apparent that there was a large retention in the œsophagus which was cleared only after long-continued lavage. Radiographic examination showed a marked dilatation of the œsophagus, ending at the hiatus œsophagi, where it passed into a fine-lined shadow, resembling in all respects that seen in instances of cardiospasm. There was, however, some little doubt as there was a blurring of the termination of the funnel. An ordinary stomach tube did not pass the cardia, but after a thin soft sound had been carefully passed first, a thick stomach sound was passed easily. Subsequently a Gottstein sound was passed easily and withdrawn after being filled with water, demonstrating that we were not dealing with an organic stricture. Œsophagoscopy demonstrated a greatly dilated œsophagus with marked infolding near the cardia, no evidence of tumor was to be seen, even after the œsophagoscope had been passed through the cardia. Diagnosis was therefore made of cardiospasm. His treatment consisted of feeding through a stomach tube and lavage of the œsophagus. The man rapidly familiarized himself with this technic and was able to carry it out himself without difficulty, gradually taking food by mouth until within a short time he was able to eat with comfort.

On examination, June, 1922, he appeared in perfect health and had since April, taken all of his meals normally, but was careful to have the food in a fine state of division. The œsophagus apparently emptied itself completely. His weight had increased 3½ kg. Final radiological examination shows a practically perfect recovery of the function of the œsophagus. There remains a moderate degree of dilatation which, however, is greatly reduced.

CASE II.—Female, age sixty-six. Complained of difficulty in swallowing for more than a year of varying degrees, but lately very little food has passed into the stomach and patient has been rapidly failing.

The examination showed practically the same findings as noted in the previous case with, however, the difference that we were not able to pass the cardia with the œsophagoscope and only succeeded in getting into the stomach with the stomach tube after preliminary sounding with a thin malleable sound. Later we were able to dispense with this preliminary sounding. The slow progress of the illness justified our inferences that the case was certainly one of cardiospasm. During the course of her treatment she developed a peritonitis which, however, was not caused by perforation of the œsophagus, and on laparotomy examination of the cardia and stomach did not show the presence of any tumor. It was noted that the intra-abdominal part of the œsophagus was very long, as occurs so frequently in cases of cardiospasm. While the general condition of the patient has improved greatly under this treatment, all evidence being to the effect that we were dealing with cardiospasm. Trial omission of the stomach tube feeding has not as yet been made, and we have not been able to judge of the functional recovery of the œsophagus.

While as stated previously, the greater percentage of instances of cardiospasm have been observed in middle-aged patients, here we find two cases in whom the condition has occurred, one at the age of fifty-eight, and the other at the age of sixty-five, therefore one should be careful not to make a diagnosis of carcinoma of the œsophagus, however probable it may be, merely on account of the age of the patient and allow the patient to suffer unnecessarily from the lack of treatment which will make them entirely comfortable.

The first case shows how completely recovery can be obtained in a case of cardiospasm from stomach tube feeding and the ultimate restoration of the œsophagus obtained, as demonstrated radiologically. This case apparently negates the argument that cardiospasm follows a primary mega-œsophagus as promulgated by Von Hacker and Sencert.

However, this simple treatment is not always so effective as in the case quoted as noted in a previous communication,<sup>1</sup> in which such treatment was entirely ineffectual during two and one-half years, while subsequent operation by Heller led to a very considerable lasting improvement with practically recovery of the case. However, the treatment of lavage of the œsophagus and stomach tube feeding is so simple that this class of case should be given a thorough trial with it first. Operative intervention is naturally of a more serious character and even the dilatation treatment with the Gottstein sound is not without its dangers. Cases in which this has been used have suffered from perforation with subsequent death.<sup>3</sup> Plummer and Porter report seventy-five per cent. of 301 cases relieved by divulsion, obtained by means of a hydrostatic dilator with pressure of thirty feet of water, although in the beginning of this treatment they lost two patients from rupture of the œsophagus. Naturally, if it is impossible to pass the stomach tube through the cardia, the case cannot be treated as the two cited in this article have been, and one may attempt sounding under the circumstances, passing the sounds under guidance of the œsophagoscope, as recommended by Benjamins in Holland and Guisez in France.



## CARDIOSPASM IN THE AGED

In many of these cases in which at the beginning it was impossible to pass the cardia, it has been possible to eventually accomplish this by beginning with a thin pliable bougie with terminal olive bulb, with which one may in many instances succeed in passing the cardia. This should be followed by increasing the graduated sizes after which the stomach tube may frequently pass with ease, which primarily was impossible.

It is our custom, therefore, to only consider operative intervention as the last resort. The usual method employed in Holland is that of Heller, in which a longitudinal incision is made across the narrowed part and deepened as far as the mucosa. We have now employed it in eight cases without mortality. The results are very satisfactory, although subsequent radiologic examination show that a condition of *restitutio ad integrum* has not been effected. It does not appear to make any difference relative to the subsequent findings whether the incision is made on the anterior side and one on the posterior side as Heller<sup>4</sup> did, or one incision only on the anterior side as has been employed by de Bruine, Groeneveldt and myself. Heller points out that he considers it necessary to lengthen the incision particularly downwards, whereas it need only to be carried upwards as far as the beginning of the dilatation.

### REFERENCES

- <sup>1</sup> Zaaijer: Cardiospasmus en andere slokdarmaandoeningen, S. C. von Doesburgh, Leiden, 1918.
- <sup>2</sup> Acta oto-laryngologica. Vol. ii, Fasc. let. 2, p. 188, 1920.
- <sup>3</sup> Plummer and Porter: Med. Clin. of N. America (Mayo Clinic, Nr.). Bd. 5, Nr. 2, pp. 355-369, 1921.
- <sup>4</sup> Verhandlungen der Deutschen Gesellschaft für Chirurgie, 1921. I. S. 144.

TRANSACTIONS  
OF THE  
PHILADELPHIA ACADEMY OF SURGERY

*Stated Meeting Held December 4, 1922*

The President, DR. JOHN H. JOPSON, in the Chair

ACTINOMYCOSIS TREATED WITH COPPER SULPHATE

DR. ROBERT H. IVY presented a female, aged twenty-eight, housewife, whose present trouble began in July, 1922, when she noticed soreness in the left lower molar region. The first and third lower left molars became loose and were extracted between the first and the tenth of July. This was followed by swelling of the tissues overlying the mandible on the left side and finally pus broke through the skin just beneath the left side of the chin.

Patient was first seen August 18, 1922, when there was a sinus discharging pus at the point mentioned. The whole left side of the face was considerably swollen, indurated, and painful, with marked trismus. Patient was admitted to the Polyclinic Hospital, Philadelphia, on August 24, 1922, with a diagnosis of periostitis of left body and ascending ramus of mandible, probably of dental origin. The radiographic examination was negative for any bone lesions. August 25, 1922, under gas-oxygen anæsthesia, an incision was made beneath left angle of mandible, some thick pus obtained near the periosteum, and a rubber drainage tube inserted. Culture from the pus revealed only a staphylococcus. The condition improved for a time, but induration and purplish discoloration of the skin remained. Another focus of suppuration gradually appeared in the region of the left zygomatic arch. September 8, 1922, a small incision above and parallel to the arch was made, thick pus escaping. A Carrel tube was passed down beneath the zygomatic arch and brought out of the old incision at the angle of the jaw. The opening just to the left of the chin had also again opened spontaneously. Smears from the pus showed no microorganisms. Irrigation with Dakin's solution was carried out for about a week with beneficial results, after which the rubber tube was removed. The temperature at no time had been above 101 degrees, and was generally below 100. General condition of the patient was good. September 22, 1922, the swelling and evidence of suppuration having again appeared near the lower openings, smears were carefully made from some small granular flakes in the pus, and branching rods, in some cases with clubbed ends, were found, identified as actinomyces. Repeated attempts at culture of the organisms from the pus, anaërobic and aerobic on various media, failed entirely. Complement fixation of patient's serum was negative, Doctor Kolmer using as antigen a stock culture of actinomyces bovis. Agglutination tests

with the same culture were also negative. The skin reaction was doubtfully positive. However, since the branched and clubbed rods were repeatedly found in smears made from the sulphur-like granules appearing in the pus, this was considered sufficient for diagnosis and the case was thereafter treated as actinomycosis.

September 27, 1922, following the suggestion of von Baracz (*Zentralbl. für Chir.*, May 6, 1922), under local anaesthesia, 15 c.c. of a 1 per cent. solution of copper sulphate was injected directly into the indurated tissues, particularly the parotid region. This was very painful and produced a marked temporary increase in the swelling, with oedema extending to the left eyelids. The sinuses at the same time were curetted and swabbed with tincture of iodine. This was followed after a few days by a marked increase in the flow of pus and the tissues became softer. The wounds were irrigated daily with 1 per cent. copper sulphate solution and swabbed with tincture of iodine. Ten days after the first injection, under gas-oxygen anaesthesia, 12 c.c. of 1 per cent. copper sulphate solution was injected into the most indurated part which was now about the left angle of the mandible. The inflammatory reaction was not as marked as after the first injection, and subsided more rapidly. On October 1st, internal administration of potassium iodide was also begun, with 5-grain doses three times a day, rapidly increased to a maximum of 30 grains three times a day, which was continued until November 1, when the amount was gradually reduced and finally discontinued.

The patient was discharged from the hospital on October 14, 1922, since which time there has been a gradual subsidence of the swelling. On November 13th, all sinuses had healed, induration was gradually disappearing, and the patient was able to open the mouth much better. There was a slight paresis of some of the muscles of expression about the mouth and eyelids. On November 27th, at the site of one of the old sinuses over the ascending ramus of the mandible, a small area of softening appeared and on opening into it a thin fluid with a few granules was obtained. Actinomyces were found in smears made from the granules. Although this new wound remained free from suppuration after opening, another parenchymatous injection of 5 c.c. of 1 per cent. copper sulphate solution was given on December 1st. While too recent to venture a definite opinion, the favorable influence of previous injections and the small size of the new lesion lead to the hope that a permanent cure will soon follow.

Actinomycosis, in this part of the country, is decidedly rare, or at least is infrequently diagnosed. He believed, however, that these cases are more common than is ordinarily recognized. In the beginning, when it affects the region of the angle of the mandible, the disease cannot be distinguished from an ordinary subacute periostitis of the lower jaw of dental origin. There are soreness and loosening of the teeth, deep-seated swelling, induration and trismus. Later, areas of softening occur, with the appearance of chronic discharging sinuses. Actinomycosis, therefore, should always be

considered as a possibility in any long-standing case presenting these symptoms. Absolute diagnosis of course rests on the finding of the organism in the sulphur-like granules in the pus. Two years ago a case was seen with almost identical history and symptoms as the one reported here, and was treated for several weeks as an ordinary infection of dental origin, until finally the specific organism was found.

The employment of copper sulphate as a specific in actinomycosis was first suggested by Bevan (*Jour. A. M. A.*, November 11, 1905). He used it internally as a substitute for potassium iodide in doses of from one-fourth to one-half a grain, increasing the dose if necessary to one grain, three times a day, and also employed a 1 per cent. solution for irrigation of the sinuses.

Von Baracz (*Zentralblatt für Chirurgie*, May 6, 1922) reports that in nineteen years he has observed 36 cases of actinomycosis and successfully treated 35 of them by infiltrating the affected tissues with a weak solution of copper sulphate (one-half to one per cent.). From 10 to 40 c.c. of the solution are injected with a hypodermic syringe every ten days to two weeks, two, three or four injections being necessary according to the severity of the case. The injections are combined with opening, curettement and drainage of the lesions and irrigation of sinuses with the copper sulphate solution after swabbing with tincture of iodine. The favorable results in this large series of cases render this method of treatment at least worthy of extensive trial.

#### HELIOOTHERAPY FOR TUBERCULOSIS OF BONES AND JOINTS

DR. A. BRUCE GILL, in order to demonstrate the results of this treatment, exhibited the following cases:

CASE I.—The patient was admitted to the Widener Memorial School for Crippled Children in 1910, when seven years of age. She was suffering from tuberculosis of the left hip which had been present for more than three years. There was considerable thickening about the hip at that time but no abscess formation. A year after her admission abscess formed and opened spontaneously. During the next two years the sinus closed twice and remained healed for some months, but each time reopened. The patient had been steadily gaining weight and her general condition was good. In 1913 the sinus began to discharge profusely and the patient developed an irregular fever and steadily lost weight. By the early part of 1914 both the general and local conditions had become very bad. The soft tissues about the hip and the thigh were gradually absorbed until the base of the neck of the femur, the great trochanter, and two-thirds of the shaft were protruding from the wound. The edges of the wound were of a pale blue and unhealthy color. The wound kept enlarging steadily. She was running a septic temperature with daily variations of four to six degrees. She had been kept under the best of hygienic conditions, being exposed daily to the fresh air, and supplied with the best of food. Intensive dosage of X-ray had been employed without avail, and it seemed but a question of a short

time until she should die. About the first of April, 1914, we began to expose her naked to the sunshine as advised by Doctor Rollier. About the first of June she was taken to the summer branch of the Widener School at Longport, New Jersey, which is on the seashore, and her treatment by heliotherapy continued. By the first of September her temperature had fallen and was ranging then between 98 and 100 degrees. The wound had begun to show signs of healing. Heliotherapy was continued as far as weather conditions permit during the winter in Philadelphia, and during the summer at Longport. At the end of two years' time her wound was completely healed, her weight had gone from 37 to 61 pounds, her general condition was splendid and she was going daily to the schoolroom. By 1918 her weight was 104 pounds. The wound had remained entirely healed. There was no deformity at the hip-joint, which was ankylosed. In 1919, a skin plastic operation was done to cover over the exposed femur which was visible almost down to the knee-joint. She left the school several years ago and has been earning her living since her graduation. As you observe, the wound has remained entirely healed and the general condition of the patient is all that could be desired.

CASE II.—This child was admitted to the Widener School in 1918, suffering with tuberculosis of the hip. At the time of admission she had fourteen discharging sinuses about the hip. All the structures were boggy and exuding pus. Under heliotherapy her sinuses completely healed in two years and have remained healed since. The soft tissues about the hip and the thigh are firm to the touch and the skin of her entire body, as you observe, is thoroughly browned.

CASE III.—This boy was admitted to the Widener School with a number of discharging sinuses at the hip. He became healed by heliotherapy during the first summer at Longport.

CASE IV.—This boy was admitted to the school last spring. He had numerous sinuses, with profuse discharge, and his hip was very painful. He was practically healed during the summer at Longport.

These few children are presented from among many to serve as object lessons to show how the most severe cases may be cured by heliotherapy within a comparatively short period. There is no question in the minds of many who have employed this method of cure that it is of the greatest value. Apparently hopeless cases have been completely cured within a period of two years, while milder cases are cured within a few months. This method of cure of surgical tuberculosis is largely due to the work and the writings of Rollier. Koffman, of Odessa, some years ago reported very favorable results of heliotherapy as practiced on the shores of the Black Sea, and American orthopaedic surgeons have employed it with success both on the seashore and in the interior. Other writers have noted cures on the shores of the North Sea. Rollier's work, as you are aware, has been done in the French Alps, at an altitude of 3500 to 4000 feet.

It has been found that the treatment during the summer months at the seashore is worth very much more than the treatment during the eight or nine

other months of the year in Philadelphia. Rollier's dictum is that the progress of the cure is measured by the extent of the tanning of the skin. This appears to be true and all are aware how much more readily the skin becomes browned at the seashore or on the water than it does inland. Unquestionably the greatest value from this method of treatment can be obtained in climates where the sun is warm and where there are few cloudy days. Unfortunately in this climate, except in the summer, there are many cloudy days, and in the neighborhood of cities the effect of the sunshine is lessened by the smoke and dust in the atmosphere. At the same time surgeons in whatever locality and climate would do well to employ heliotherapy to the largest possible extent in cases of tuberculosis of bones and joints. Sinuses under this treatment discharge more profusely for a time, but in time the discharge becomes more and more serous and then lessens until finally the sinus heals. Painful joints soon become painless, the appetite of the patient becomes better and his general health markedly improves. Long after the sinuses have closed it is wise to continue the heliotherapy for a period of months and years, as has been done in these cases.

DR. GEORGE M. DORRANCE remarked that he had lately visited Rollier at Lysen and saw there 1200 cases of surgical tuberculosis under treatment. He insists upon rest with moderate extension and gradual active and passive motion. No massage is employed. There were cases that from X-ray examination looked like bony ankylosis in whom he had obtained limited motion. He does not believe in the Albee operation. All plaster cases are removed when the children come to him. He believes that altitude, heliotherapy, rest, and food is the solution of the treatment of bone and joint tuberculosis.

#### PERFORATED MECKEL'S DIVERTICULUM

DR. DAMON B. PFEIFFER showed a girl, aged five years, who was admitted to the Abington Memorial Hospital, August 14, 1922, complaining of severe pain in the abdomen. There was no history of indigestion or of abdominal pains. At midnight, prior to admission, she was seized with severe pain in the lower abdomen and vomited three times. The abdominal pain continued, severe and constant. There had been no action of the bowels since onset. On admission at 3 P.M., the pain had abated. She was quiet, her face was pale and slightly pinched, the sensorium unaffected. Temperature, 99.6°; pulse, 120; respiration, 32. Physical examination: The abdomen was moderately distended and tympanic. Almost board-like rigidity was present. Tenderness was general, but most marked in the right lower quadrant. Faint peristalsis could be heard at long intervals. No peculiarity of the umbilicus was noted. The urine was normal, hæmoglobin was 79 per cent. (Dare), leucocytes 9800. She had been sent to us with the diagnosis of appendicitis, and was operated upon for this condition, the rapidity of onset and extreme rigidity suggesting perforation.

The abdomen was opened by a McBurney incision. On incising the peritoneum there was a gush of thin blood-stained fluid. The possibil-

## MULTIPLE FRACTURES OF THE PELVIS

ity of intussusception was at once considered, and two fingers introduced for exploration, encountered a movable mass about the size of a walnut. This was withdrawn through the incision, and found to be a loop of ileum with a grayish-yellow rounded mass intimately incorporated with the side of the intestinal wall and the adjacent mesentery. There was a small perforation near its attachment to the bowel, through which a small amount of clear fluid was escaping. From the edges of the perforation there was a slight bloody ooze. The intestines were intensely congested, slightly distended and a few patches of fibrin were seen on the surface. The mesentery was studded with lymph-nodes varying up to 1.5 cm. in diameter. The appearance was that of tuberculous mesenteric nodes, and the larger mass, above noted, seemed to be an unusually large node which had perforated acutely. It was evident that the perforation could not be repaired, and it was therefore determined to make a resection and end-to-end anastomosis, which was done. The appendix was inspected and found to be bound down by adhesions. It was removed. In the belief that the underlying process was tuberculous, drainage was omitted and the abdomen closed in layers.

Convalescence was stormy for the following two days, temperature reaching as high as 103.3 and pulse 156. Distention was extreme. All symptoms then abated rapidly, and on the seventh day her temperature, pulse and general condition reached normal.

Pathological examination of the specimen showed the mass to be a Meckel's diverticulum, greatly thickened, curved upon itself, covered with adhesions and rotated until it seemed to lie within the convexity of the mesenteric border. Evidently a chronic process had existed for a considerable period without exciting localizing abdominal symptoms. The enlarged glands of the mesentery were the local result of absorption.

## MULTIPLE FRACTURES OF THE PELVIS

DR. H. A. McKNIGHT presented a patient C. L., who was admitted to the Medico-Chirurgical Hospital, February 8, 1922, with a history that she had fallen from a third-story window, landing on the pavement on the buttocks. The patient who was very obese was suffering from acute alcoholism, and was badly shocked; pulse absent at the wrist, skin cold and clammy and temperature 96°.

On examination a separation of the symphysis pubis of over two inches was discovered, another fracture was found on the left horizontal ramus of the pubis, and there was undue mobility of the iliac crest. An X-ray showed: (1) Complete transverse fracture through the left side of the sacrum with displacement upwards of approximately 4 cm. of the fractured fragment of the sacrum. The relations of the fractured fragment to the left sacro-iliac joint were not altered, except that the left side of the bony pelvis was displaced upward. (2) Complete separation of the bones of the symphysis pubis 4 cm. (3) Complete transverse fracture through the os pubis. (4) Comminuted fracture at the junction of the ischium and ascending ramus. (5) Fracture of the descending ramus of the pubis left side, but the line of fracture was not

clearly and distinctly shown. (6) Tuberosity of the ischium crushed upward, almost obliterating the obturator foramen.

Reduction under ether anæsthesia. The ilium was grasped and pulled downward, one hand in the vagina manipulated the bone of the lateral wall of the pelvis and the patient was placed in a sling. On April 4 another X-ray was taken. Apposition and alignment of fragments of sacrum, ischium and pubis good. Transverse process of fifth lumbar vertebra left side shows upward tilting. The symphysis separation was markedly improved over last examination. There was still separation of approximately 3.5 cm. Examination on discharge from hospital: Ensiform to internal condyle 49 inches on right side. Ensiform to internal condyle 48¾ inches left side. Full motion of the hip on the right side, musculature on right flabby. Muscles of left thigh flabby; patient complains of pain in left thigh on flexion of the leg though the left moves equally with the right. Complains severely without physical cause, except disuse and inaction. Pubic arch nearly closed and not more than ¼ inch separation. No pain on concussion over left iliac area, no mobility nor tenderness at former points of pain. Vaginal examination: No mobility of pubic bones. There is slight impinging of the pubic bones on the pelvic space. Walks with slight limp.

#### FRACTURE OF THE SKULL

DR. H. A. McKNIGHT showed a second case of a patient, M. E., age twenty-four, who was admitted to the Polyclinic Hospital, September 27, 1921, suffering from multiple lacerations of the scalp, stab wounds of the neck, a punctured left eyeball and a fractured skull. The lesions were produced by the blows of a hammer. On admission the patient was semiconscious, the left temporal and parietal regions of the skull were depressed, and on palpation over this area a sensation was transmitted to the fingers as if one were handling a bag of marbles. Brain substance was issuing from the lacerations in the scalp and the left eyeball was collapsed.

Operation was performed at once. A large fronto-temporal flap was made extending to and beyond the sagittal suture; from this lateral extensions were cut to the right along the coronal suture and posteriorly. On raising this flap it was seen that the temporal and a large part of the anterior part of the left parietal bone was comminuted and driven into the brain substance. These bones resembled a tessellated pavement, each mosaic of which had been separated and lying free. The frontal bone was also fractured and the fragments were driven into the frontal lobe. The roof of the orbit was fractured and driven upward, and the nasal bone was crushed and driven upward and backward. The frontal lobe was torn and lacerated.

The bone fragments were removed, the lacerations in the dura closed, after extracting the fragments of bone from the brain, the left eyeball was enucleated and the scalp wound closed with drainage. On October 8th, a neurological examination, a slight weakness in the right grip, a suggestion of a Babinski on the right. There is some confusion and



## SUBACUTE MASSIVE PROCTITIS

memory loss of the time of the accident and the time immediately following. Memory for details of the exact present is incorrect. This is no more than is to be expected from the site of the injury. Patient had an uneventful recovery. The wound healed by first intention and she was discharged from the hospital October 17th. At this time there seemed to be no mental nor motor disturbances.

## SUBACUTE MASSIVE PROCTITIS

DR. E. L. ELIASON, not having been able to find any description of a similar condition, presented the following case:

Case No. 8535, Mrs. J. P., age thirty, had been sick for five weeks, being seized in the beginning with cramp-like pains in the lower abdomen, associated with backache. A diagnosis of extra-uterine pregnancy was made, but operation was refused. Four weeks later she was again seized with pain in the lower abdomen, most marked on the right side, associated with vomiting and constipation, temperature of 100 to 101.

The patient was somewhat jaundiced at time of examination and was found to have a distended, tender abdomen, with some rigidity and especial tenderness in right iliac fossa. Palpation found a mass here, just under the rectus muscle, and extending to its outer border. It was hard, smooth, fixed, and somewhat tender. Vaginal examination revealed a very high-placed uterus, the cervix being barely within reach of the finger. The uterus was freely movable and the appendages showed no evidence of pathology. Posterior to the uterus was a marked massive induration bridging over the rectum and extending down on each side almost to the anal canal. Rectal examination revealed an indurated, rigid rectal wall constricting the lumen so that it admitted only the examining finger. A diagnosis of pelvic abscess secondary to a ruptured appendix was made. Leucocytes, 17,000. Wassermann, negative.

Patient was operated at Howard Hospital through right rectus incision. The abdomen contained a quantity of bile-stained fluid. The gall-bladder, appendix and Fallopian tubes were normal. Further examination revealed a rigid, indurated and markedly enlarged oedematous rectum and lower two inches of sigmoid. The condition evidently had existed some time, for the tissues pitted only with continued firm pressure. The rectum could not be compressed or moved the slightest. It presented a yellowish, smooth semi-translucent appearance, due to the bile-stained oedema. No fecal impaction existed. Left inguinal colostomy was performed. One week later, under hot rectal irrigations, twice daily, examination showed decided local improvement. Three weeks after colostomy patient began having bowel movements per anum. Examination found oedema and induration entirely gone. Four weeks after operation the colostomy was closed by excision and end-to-end anastomosis. Pelvic examination through the abdominal wound demonstrated a normal sigmoid and rectum. Patient to-day is perfectly well; has gained forty pounds. Bowels are regular with use of paraffin oil occasionally.

DR. GEORGE P. MULLER recalled a case operated for carcinoma of the rectum in which he noted a tremendous thickening of the wall and narrowing of the lumen for six or seven inches. Recently in a patient with diverticula of the colon, in addition to many small diverticula there were three local processes, one below the splenic flexure, one at the beginning of the sigmoid, and another at the rectum. He could feel a mass low down in the pelvic colon near the bottom of the peritoneal reflexion. It was distinct and felt like the one Doctor Eliason described. The case might have been one of small diverticula surrounded by exudate, as one rarely sees the diverticulum and yet the peritoneal diverticulum may be behind. In 1910 in *Surgery, Gynecology and Obstetrics* a case was reported where the lower sigmoid was surrounded by a mass of tissue obliterating the lumen. Braun reported a case of tumor of the sigmoid and says that this condition is entirely distinct from malignant disease.

DR. DAMON B. PFEIFFER said he had never encountered an exactly similar condition, but had seen some cases which probably fell into the same group. The interstitial inflammations which affect the rectum and large intestine are not as yet thoroughly understood. Inflammation and pathologic changes, consequent upon infection by the amoeba, the various strains of dysentery bacilli, by tuberculosis, syphilis, and occasional rarer types of infection, are well known, but there remains a residuum of cases of severe and even fatal proctitis and colitis, the etiology of which is unknown. Such cases occur sporadically throughout the entire United States, and in the aggregate there is an enormous number of them, but as yet insufficient attention has been accorded them by the profession. Many of these cases present a symptom-complex so similar that it seems probable that they represent a distinct clinical entity; though as yet, no satisfactory designation has been given to them. Probably the most common term is chronic ulcerative colitis. This is unsatisfactory, because in the early stages the condition is simply a diffuse inflammation of the wall of the bowel, with a characteristically thick, opaque, red, friable and bleeding mucous membrane. Also in the latter stages, ulceration may have been largely or entirely overcome, leaving scarring, contraction, more or less absence of haustration, and frequently polyp formation.

It must be noted that all these more serious manifestations are interstitial inflammations and the thickening of the bowel wall may be extreme. Frequently, the entire large intestine and rectum are involved, but at times only a localized segment is affected. The rectum almost always participates. By analogy, it seems reasonable to infer that all these processes are infective in origin. Culturally, many varieties of pathogenic bacteria have been obtained, but it is difficult in the presence of the intestinal flora to be certain as to the rôle played by each. It seems probable that the pathogenic micrococci can produce a diffuse inflammatory condition of the large intestine, but the conditions which predispose to such infection are unknown. Of course, one could not rule out the possibility of infection by some organism or organ-

## SUBACUTE MASSIVE PROCTITIS

isms as yet undiscovered. It seems to me that Doctor Eliason's case would fall into the group of non-specific interstitial infection of the rectum and colon. It is remarkable in its degree and its localization.

DOCTOR ELIASON, in closing, remarked that he had seen a condition similar to the case cited by Doctor Muller, from whom he had removed the appendix and who six days later developed an intestinal obstruction. Upon opening the abdomen, no cause could be found for the obstruction; the gut was distended down into the pelvis; here the hand felt the rectum similar to the one just described. It was probably an interstitial proctitis.

TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY

*Stated Meeting Held December 13, 1922*

DR. ELLSWORTH ELIOT, JR., in the Chair

CANCER OF PROSTATE

DR. WILLY MEYER presented a patient, now seventy-two years of age, who had been under his care since November, 1917. He had been seen previously, in September, 1917, by Doctor Barringer, who took him to the General Memorial Hospital for radium treatment, without improvement. He showed the pathognomonic signs of cancer of the prostate gland and it was considered advisable, in view of his general condition and age to avoid a radical operation but to again try radium. A water-tight suprapubic fistula was established according to Witzell through a stab in the bladder. The radium treatment was begun immediately. In all he received eight therapeutic applications of radium per rectum and over the symphysis, and about twenty-five prophylactic applications. Today the patient is in splendid health and travels in comfort. He still wears his catheter. It has been thought inadvisable to discontinue the catheter. The fistula is water-tight, he receives careful attention, and the bladder is washed out regularly. Rectal examination shows the prostate much shrunken, flat and hard. The nodular condition has disappeared.

DR. EDWIN BEER asked if the patient could urinate. Without microscopic confirmation one should be chary of subscribing to a diagnosis of carcinoma. Numerous cases of non-carcinomatous prostates (adenoma prostatitis, prostatic stone) may closely mimic malignancy. There is also a marked variability in the life history of prostatic carcinoma quite independent of treatment.

DR. MEYER replied that the patient could urinate. There could be little doubt as to the diagnosis of carcinoma; the tumor had been nodular, the trouble had developed quickly and the patient certainly had been in no condition for radical operation.

RADIUM BURN OF FOOT

DR. WILLY MEYER showed a second patient who had had a general eczema for which radium was applied on the left foot behind the inner malleolus for twenty minutes. After two or three weeks an ulcer developed. We know that radium produces a sclerosis of the nourishing blood-vessels exposed to it and that this has to be considered in every case of a radium burn. Usually these ulcers due to radium or X-rays do not heal; they are extremely obstinate. As the only possible alternative to excision, hyperæmic treatment was considered. It consisted

## FISTULA FOLLOWING NEPHRECTOMY FOR TUBERCULOSIS

of wearing a rubber bandage around the thigh over night and regular cupping. This treatment was kept up for about ten weeks and the result is that the ulcer has healed and has remained so for eight months.

## FISTULA FOLLOWING NEPHRECTOMY FOR TUBERCULOSIS

DR. WILLY MEYER presented another patient, twenty-six years old, who in 1919, presented signs of a suppurating kidney. Cystoscopic examination demonstrated thick pus escaping from the left ureter; the right kidney negative. Operation was planned in two stages with local anæsthesia, but it was found that there was not a single large sac that could be drained; the kidney was typically tubercular. Therefore she was given a general anæsthetic and the organ was shelled out of its much thickened capsule. A mass ligature, applied low down, surrounded the voluminous lower part of the pelvis. The ureter had to be left in place. The entire wound was left open and it healed nicely up to a sinus.

Several earlier cases of tuberculous kidney where the kidney was shelled out from its capsule, had later developed a sinus. They had been successfully cured with the injection of a solution of sulphate of copper and sulphate of zinc in water. In this case this treatment was tried twice, but the sinus persisted. Having seen a patient with a persistent sinus in tuberculous empyema benefited by the light treatment, the Kromayer lamp with a special quartz probe was used in this case for several months. Twice the wound healed, but reopened. The radio-therapeutic department of St. Luke's Hospital was asked to take an interest in the case, and there she was submitted to intermittent X-ray treatment. After some time the wound closed and has remained closed now for over eight months. The patient is in good health and apparently cured.

DR. JOSEPH WIENER said that he had been able to cure sinuses in every part of the body with the Coolidge tube, but the best results had been accomplished in cases of tuberculosis. A powerful X-ray tube is used and the light is filtered so that the soft rays do not reach the patient. This treatment is of great value for sinuses of every kind, even of the bone, but the results are most striking in those cases in which tuberculosis forms the etiologic factor.

DR. EDWIN BEER remarked that unfortunately these tubercular cases are followed too often by persistent and rather obstinate sinuses. Doctor Meyer's remarks would lead one to believe that if more of the ureter was taken out this would not occur, but statistics fail to confirm this. Even after complete aseptic uretero-nephrectomy, lumbar sinuses are quite frequent. In Doctor Meyer's case he left the capsule of the kidney, and this might be an explanation for the persistence of the sinus as it probably was tuberculous. It was the speaker's own opinion that frequently this was a secondary hæmatogenous infection of the musculature following the manipulations incidental to nephrectomy. In these obstinate cases one is forced from one treatment to another. Cases have been known to drag on for as long as four years and then close. X-rays, heliotherapy, or bismuth injections, etc., all have to be tried to assist in closing

these chronic sinuses, but no one therapeutic measure seems to be regularly successful, and it is difficult to decide which therapy has been effective, as so many close under ordinary surgical measures.

#### EXTRAPLEURAL THORACOPLASTY FOR PULMONARY TUBERCULOSIS

DR. WILLY MEYER also presented a patient who four years ago came under his care in a much reduced condition with bilateral pulmonary tuberculosis. He decided to do an extrapleural thoracoplasty in two stages, and this procedure was carried out on November 18, and on December 10, 1918, resecting the sixth to tenth rib first, and the second to fifth rib at the second sitting. (The case was described in *Surgery, Gynecology and Obstetrics*, February 1920.) On the outside of the chest elastic compression was also employed. The patient has done very well. All his former symptoms as well as the bacilli disappeared and he was able to attend to his work. The röntgenogram shows that the other lung is in good condition; the one operated on shows a total collapse with connective tissue proliferation. It is of interest and importance that today surgery is indicated in advanced cases of pulmonary tuberculosis which medical and careful hygienic treatment have failed to help. And surgery will improve or cure 60 to 70 per cent. of these cases.

DR. HOWARD LILIENTHAL said that he had had some experience in these cases and considered that the marvellous improvement that takes place soon after the operation is quite extraordinary. Extrapleural thoracoplasty has the great advantage of fixation of the chest in addition to setting at rest the lung itself. The fixation is accomplished not only by the position of the ribs but by the bridge of bone which forms and cements them together. Part of the phrenic nerve should first be extirpated on the affected side. The results have been excellent. The speaker had only lost one case and in this, unexpected disease of the other lung had developed.

DOCTOR MEYER, in closing the discussion, said that there lately appeared an excellent article by Goetze of Frankfort from Professor Schmieden's clinic, in which it is advised that the operative treatment of lung compression should best commence, in certain cases of advanced pulmonary tuberculosis, with the resection of the phrenic nerve. It was also stated in this article that patients who have been treated with artificial pneumothorax should not be discharged before the phrenicotomy had been added.

#### LIGATION OF COMMON ILIAC WITH FASCIAL STRIP FOR ANEURISM

DR. JOHN DOUGLAS presented a man twenty-five years of age who had suffered a compound fracture twelve years previously, infection of which necessitated an amputation at junction of the upper and middle third of the left thigh. He was all right until five years ago when he noticed a mass in the gluteal region. He entered Bellevue Hospital at this time where a diagnosis of sarcoma was made. An incision was made for diagnostic purposes, and the mass was found to be an



FIG. 1.—Ligation of common iliac with fascial strip for aneurism.





aneurism, probably of the gluteal artery. No further operative procedure was carried out at this time. Two years ago he developed large veins on the stump of the thigh and in the scrotum and penis, and he was operated on for varicocele. The veins on the stump continued to increase in size as did the mass in the gluteal region, and he suffered severe pain in the region of the hip joint. He entered Bellevue Hospital on June 1, 1922.

At this time the end of his stump was occupied by a large mass of tortuous veins (Fig. 1) extending half-way up to Poupart's ligament. These veins were one-half to almost a centimetre in diameter, were compressible and a distinct thrill could be felt and bruit heard over it. This thrill and bruit, as well as the pulsation, could be detected extending well up above Poupart's ligament, apparently extending as far as the common iliac artery. There was also a hard, more deeply situated pulsating mass in the gluteal region over which also might be detected a bruit and thrill. Radiographic pictures showed an erosion and destruction of the inner half of the remaining portion of the femur at the lower third. There was also evidence of pressure erosion in the descending ramus of the pubis and ascending ramus of the ischium. Wassermann negative.

At the operation which was done on June 10th, access to the vessels being obtained through an incision above and parallel to Poupart's ligament and extending above the spine of the ilium, the peritoneum being reflected inward, the following condition was found: The external iliac was lengthened, tortuous and dilated, and before passing under Poupart's ligament, showed a fusiform aneurismal dilatation. It was about 1.5 centimetres in diameter. The internal iliac was also elongated, tortuous and dilated. The common iliac was dilated to a diameter of 2.5 centimetres, this dilation extending upward but becoming less as it approached the bifurcation of the aorta. The iliac veins were also dilated. A strip of fascia lata 25 x 2.5 centimetres was removed from the outer side of the right thigh. This was passed around the common iliac about five centimetres above the bifurcation, a knot was tied in the fascia, a chromic-gut suture was passed through the knot to prevent slipping. The fascia strip was then passed twice more around the vessel and again sutured. At the end of the operation no pulsation was felt in the external or internal iliac artery. The reason for using the strip of fascia rather than the ordinary ligature material was that the vessel was so much dilated, so large in calibre and so thin and probably diseased that it was believed that the chance of ordinary ligature material cutting through the vessel and the possibility of secondary hemorrhage would be lessened by using the broad fascial band. It was of course impossible to go above the dilated area to tie in normal tissue as is the ideal method of ligation to cure aneurism, as the dilatation extended up to the bifurcation of the aorta.

The patient made an uneventful recovery and was discharged from the hospital two weeks after his operation. One week later at the return clinic he had some painful thrombosis of the veins over the site of

amputation, but at the present time, while these thickened veins can be felt, there is evidently no blood circulating through them and there is no pulsation in the gluteal aneurism which has markedly diminished in size and the patient is free of pain.

DR. ALEXIS V. MOSCHCOWITZ could not understand why Doctor Douglas feared to ligate that vessel. It was dilated, to be sure, but apparently not diseased. The speaker ligated both the common and the external arteries at the same time with happy results.

DOCTOR DOUGLAS replied that he had remembered Doctor Moschcowitz's case but the diameter of the common iliac, in the patient presented, was between two and three times as large as was normal, with the wall distended and thinned out. He had felt that the use of either silk or catgut would make the vessel more likely to rupture as a result of cutting through with such fine material rather than with the thick strip of fascia. In Doctor Moschcowitz's case the ligation was done on a normal vessel wall which had been eroded by pressure. In the patient shown tonight quite a different condition existed.

#### TUBERCULOUS PERITONITIS

DR. CHAS. N. DOWD presented a patient, M. F., Roosevelt Hospital Surgical history, A18570, who gave an unusually long period of observation and a corresponding opportunity for studying the natural history of tuberculous peritonitis. Twenty-one years ago, when five years old she was admitted to St. Mary's Hospital for Children; Doctor Dowd operated for tuberculosis peritonitis and found the peritoneum studded with myriads of tubercles and the omentum contracted into a thick mass. She had much ascites at that time. A simple incision exposed the abdominal contents to air and to the trauma of examination and was then closed. She was then reasonably comfortable for several years. Eight years after her primary operation, a sinus opened in the original abdominal incision, discharging for a week and then closing spontaneously. Between 1913 and 1916, she had considerable abdominal pain. In January, 1916, fifteen years after her primary operation, she was admitted to the Roosevelt Hospital, on account of attacks of vomiting and pain in the region of the appendix.

*Second Operation.*—The appendix was removed. It showed no gross lesion, but the walls were more thickened than normal, possibly 2 or 3 times the normal. This gave an opportunity of studying the condition of the peritoneum. There were no visible tubercles in the region where there had formerly been so many. There were a few adhesions about the uterine appendages. The vermiform appendix was covered in by adhesions which attached it to the wall of the cæcum. The caput coli was thickened, so that it was not possible to bury the stump of the appendix in the ordinary way, but no active tubercles were present. The scar of the old incision was excised and the muscles there looked particularly strong and well nourished and the wound healed primarily. Examination of the microscopical sections from the

## INTUSSUSCEPTION IN ADULT DUE TO ADENOMA IN ILEUM

appendix and from the tissue of the abdominal scar showed no evidence of tubercle tissue.

She then continued reasonably well for about five years when she again came to the Roosevelt Hospital, September 30, 1921, on account of severe pain in the lower part of the abdomen. She had lost twenty pounds in the previous year.

*Third Operation.*—October 3, 1921 for the relief of excessive paroxysms of pain in the lower part of the abdomen. At this operation the ovaries and tubes were found encased in inflammatory tissue and were removed, excepting a small bit of the capsule of one ovary which looked normal and the base of one tube which seemed suitable for plastic repair. There was much inflammatory tissue about the uterine appendages and it was not possible to tell at that time whether the inflammation indicated fibrosed tuberculosis or some other type of inflammation. At this time further examination of the peritoneum was also possible. There was no evidence of tubercles on the parietal or intestinal peritoneum or about the caput coli. Microscopical examination of the tissue removed showed bilateral tubercular salpingitis.

Had we been positive that the inflammation in the uterine appendages was tubercular, a complete removal of the tubes, ovaries and uterus might have been considered desirable. However, she has gained twenty-four pounds in the last year. She is free from pain and feels well. Inasmuch as all tissue was removed which looked inflammatory we may well believe that the procedure was the correct one.

*Summary.*—1. She dealt successfully with her tubercular peritonitis which was scattered throughout the peritoneum, at the time of her operation in childhood. 2. Although she was able to control this general tuberculosis, she was not able to control the localized tuberculous inflammation which collected about the ovarian tubes. 3. She has improved satisfactorily, since the removal of localized pelvic tubercular tissue.

## INTUSSUSCEPTION IN ADULT, DUE TO ADENOMA IN ILEUM

DR. CHAS. N. DOWD presented a man twenty-seven years, who was admitted to the First Surgical Division of the Roosevelt Hospital, March 28, 1922. History, A 19311. He complained of paroxysmal attacks of epigastric pain which had troubled him more or less for the past six months, and which had been associated with vomiting. The recent attacks had become very severe and on admission he had been vomiting and bright red blood had come from the rectum. After reaching the hospital, he showed definite symptoms of intestinal obstruction and an operation was manifestly necessary. A six inch median supra-pubic incision was carried a little to the left of the umbilicus. A large mass of congested intestine was found and on delivering it, it proved to be an intussusception of the small intestine. The intussusceptum had slid into the intussusciens about eighteen inches. It could not be reduced by traction, but by pressing it was pushed back about eight or nine inches. The coating of the intestine then cracked and there was a distinct hole about one-quarter of an inch in diameter. This was sewed

up by catgut and two rows of thread. The intestinal wall also cracked and perforated at a lower place in the intestine, therefore a resection was done. Apparently thirty inches or more of intestine were resected. The mesentery was tied off in separate ligatures, before it was cut. There was very little bleeding from the mesentery. The edges of the intestine were cauterized beside the clamps. These ends were then closed by Glover's chromic stitches, and outer Cushing's stitches. The entire row was reinforced by a Cushing row of silk sutures. Lateral anastomosis was then made, two rows of chromic gut, inner with Glover's stitches and outer Cushing's stitches. He made an excellent recovery and left the hospital April 27th. He has been well ever since.

The intussusception was caused by a benign adenoma which was about 2 cm. in its diameter. It had grown in the intestinal wall, had projected into the intestinal lumen and had formed the apex of the intussusception. Intussusception does not often occur in the small intestine. It usually comes in the region of the ileocaecal valve. Clubbe in his recent monograph states that in 97.6 per cent. of his two hundred and fifty-three cases, the intussusception had started at or near the ileocaecal valve.

Adults do not often have intussusception unless a tumor causes it. Adenomas of the small intestine are rare. Ewing does not give them separate mention in his book on "Neoplastic Diseases," and other authors usually do not refer to them in this location or state that they are very common. Hotchkiss presented a somewhat similar case to this Society in 1916, due to an adenoma. James & Sappington of Philadelphia reported, 1917, a case of intussusception due to benign fibroma. They were able to collect only twenty-four similar cases from the literature. Eliot & Corscaden presented a very careful report of "Intussusception in the Adult," in 1911, in which they analyzed three hundred cases. One-fifth of them were due to benign tumors. Thirty-four per cent. of the benign cases were situated in the ileum.

#### ECHINOCOCCUS CYST OF LIVER

DR. CHAS. N. DOWD also presented the case of J. B. History number A 20110. Age twenty-eight, admitted to the First Surgical Division of the Roosevelt Hospital, October 15, 1922, complaining of sudden sharp pain in the region of his liver and the upper right quadrant of the abdomen. He had been in the hospital two years previously. Otherwise his health had been good. He was a native of Greece. He had been in the United States nine years, and during that period had worked in factories in different parts of the country and on a farm in the middle west. Hæmoglobin 80. Polymorphonuclears 78 per cent., white blood cells 19,900. Blood pressure 115-75, red blood cells 6,300,000. Clotting time 5 minutes. Group 11. Differential blood count:—Neut. 84, Eosi 5, Baso. 3, Mono. 3, L. Lym. 3, S. Lym. 5.

A six inch incision through the upper part of the right rectus. The gall-bladder and stomach showed no abnormality. There was however,

embedded in the under part of the left lobe of the liver, a projecting irregular shaped cyst. On incision, it showed echinococcus material which exuded, and many small daughter cysts and a considerable amount of irregular shaped whitish cyst wall tissue. At this time, it seemed wise to close the opening in the cyst so as to prevent the spread of infection. It was feared that the walls of the cyst would be ruptured and that all endeavor to enucleate the cyst would lead to the spread of the disease.

We are not accustomed to seeing many cases of echinococcus cysts in the Roosevelt Hospital. There have only been five such cases in the last seven years. This differs from the frequency in some other hospitals in this vicinity and differs very materially from conditions found in other countries; for instance in Argentina, they are said to be so common that the possibility of echinococcus disease is the first one which comes into the mind of the surgeon who is examining for abdominal surgical lesions. The results from operation there are said to be favorable in a large percentage of the cases, and enucleation is frequently accomplished. One of the visiting surgeons from South America has been enthusiastic over the results thus obtained. In Iceland also, although they are not so common as they used to be, there are still a good many echinococcus cysts, and we learn that drainage has led to good results there when enucleation was impossible. This patient made a satisfactory recovery from the first operation. We believed that it might be possible to enucleate the remaining portion of the cyst completely or failing to do that it might possibly be marsupialized.

A second operation was therefore done through the upper part of the left rectus muscle and the wall of the cyst was found much firmer than at the previous operation; a cleavage layer was found between it and the liver, which enables us to remove the cyst without undue trauma to the liver. Two cigarette drains inserted and wound closed to emergence of these drains. He is apparently cured.

An interesting side light on the surgery of the liver was noticed in the recovery of this patient. The cyst was enucleated from the liver very much as an adherent gall-bladder is taken away. There was a definite drainage of bile for several days after the operation. When such a drainage comes after cholecystectomy, one sometimes wonders whether it comes from the liver or from the cystic duct. The drainage in this instance has proved that bile may well come from the raw surface of the liver where an embedded object such as this cyst or a gall-bladder has been removed.

#### RELATIONSHIP BETWEEN INTESTINAL OBSTRUCTION, CHRONIC PERITONITIS AND MULTIPLE SEROSITIS

DR. CHARLES N. DOWD read a paper with the above title. (See page 423.)

In discussion of which DR. EDWIN BEER thought it might be of interest to relate a case operated on at Bellevue Hospital within the last few weeks which corresponded to one of the cases Doctor Dowd reported in his paper. When the patient came to the hospital he had been ill for only three days. Examination showed a mass, firm and non-tender, behind the rectus

muscle in the right iliac fossa. X-ray was immediately taken with the idea of locating the obstruction by the gas distention in the bowel which gives a clear picture, and it was found that the ascending, the transverse and the descending colon was empty, but the small intestine was distended. This method of diagnosis is very valuable and has been used frequently. Immediate laparotomy was done by Doctor Kellogg and almost the whole intestine was found bound together in a sheath of white membrane. All the small intestine and the ileum were involved in this mass of tissue. The patient died, but the autopsy was very instructive. There was no adherent pericardium (Peck's pericarditis, pseudocirrhosis) and there was no endophlebitis of the hepatic veins. The liver and spleen were covered with this white membrane and the lower part of the ileum and cæcum and ascending colon were covered by the membrane which was as white and thick as a visiting card. Besides, there was a mass in the pelvis, a retroperitoneal lipoma, and the patient had a lipoma in his neck. There was fluid in the peritoneum. His case corresponds rather accurately with Doctor Dowd's case of polyserositis and would be classified as an "iced liver" and "iced spleen" (so called Zuckergus) with chronic productive peritonitis. The speaker believed these cases to be more common than Doctor Dowd's report suggests, although it must be admitted that they are very unusual on a surgical service.

DR. HENRY H. M. LYLE said that in working up the subject of linitis plastica in 1911, he was very much struck by the number of times this condition was associated with the condition described by Doctor Dowd, especially with some cases reported by Krompecher. The details, conclusions and literature will be found in the article Linitis Plastica by H. H. M. Lyle, *ANNALS OF SURGERY*, November, 1911. Krompecher holds that gastro-intestinal sclerostenosis is not a mere disease of the pylorus, but is found in the intestines and peritoneum, and that it is the result of a chronic venous oedema caused by cardiac insufficiency and arteriosclerosis, and that the pathological process bears a close relationship to scleroderma.

DR. HOWARD LILIENTHAL called attention to the danger of appendectomy in cases in which there is a suspicion of tuberculosis. In two cases that he knew of where this was done the union broke down and the patients had permanent fistulas. This warned him not to take out the appendix unless there were symptoms which would make it imperative. He understood Doctor Dowd to say that he had been unable to invert the stump.

DR. CHARLES GORDON HEYD said that he had had the opportunity of observing the life history of a patient with tuberculous peritonitis. In August, 1916, the patient was moribund with marked ascites and a laparotomy was performed under local anæsthesia and the abdominal cavity irrigated with 50 per cent. hydrogen peroxide solution. In September, 1920, the patient was reoperated upon for a mass in the right lower quadrant of the abdomen. Upon laparotomy the upper abdomen was entirely free of any evidence of tuber-

culous mass and a salpingo-oöphorectomy was performed. The left tube and ovary were not involved. In February, 1921, a third laparotomy was performed for intestinal obstruction. Aside from some adhesions of the omentum to the anterior abdominal wall there was no evidence of any tuberculous process in any portion of the abdomen. When last seen about three months ago, the patient was entirely well. In regard to chronic multiple serositis Doctor Heyd was under the impression that ascites was essential to the diagnosis and many of the cases of multiple serositis were extremely chronic. In Osler's cases a child was tapped 121 times and Rumph's patient was tapped 301 times and there was in the literature a reported case in which 600 gallons of ascitic fluid was removed within a period of five years. It seemed that there were many cases of hyperplastic peritonitis with mucosal obstruction which were accidentally discovered on laparotomy. Whether these belong to the group of multiple serositis was doubtful as it would seem that the history of ascites was essential in establishing the clinical entity of chronic multiple serositis.

DR. ELLSWORTH ELIOT, JR., also spoke of the removal of the appendix in a case of tuberculous involvement. He thought a distinction ought to be made between those cases in which the tuberculosis was part of a general involvement of the peritoneum and those in which the tuberculosis was limited to the appendix alone. Of the latter type he had had three cases in which the removal of the appendix was not followed by any untoward result, the wound healing without difficulty. Of tuberculous peritonitis he recalled one case, a five year old child, in which, after the usual operation, a fecal fistula developed. With ordinary cleanliness, good care and nursing the fistula closed spontaneously. Fifteen years afterward the patient, then an adult, enjoyed perfect health with no indication of tuberculosis in any part of the body. Such cases of "healed" tuberculosis, although at the time of operation limited to the peritoneum, are not necessarily safe from recurrence, either in the peritoneum or in other parts of the body. Once tubercular, patients are subject to the danger of relapse even though they may continue in perfect health for a number of years.

DOCTOR DOWD, in closing the discussion, said that the removal of the appendix in the case of tuberculous peritonitis was done fifteen years subsequent to the discovery of the tubercles in the abdomen, and at a time when there was absolutely no evidence of active tuberculosis. Doctor Heyd's remark about ascites is in conformity with the usual description of multiple serositis, for it has usually been the ascites which has called attention to the disease, but this ascites is not always present. The profession is indebted to Doctor Mayo for again calling attention, last summer, to the possibility of extensive disease without ascites. We may well believe that many cases exist in whom the disease escapes diagnosis because ascites is not present.

## CORRESPONDENCE

### THE URETER VERSUS THE APPENDIX IN RIGHT-SIDED ABDOMINAL LESIONS

EDITOR ANNALS OF SURGERY:

Sir:

An healthy skepticism should be entertained for an appendix whose sole plea for removal is the detection, by the examiner, of an ill-defined iliac tenderness, and a total absence of a substantiating, clear-cut, acute history. In a recent review of errors committed by myself and others, it was found that, in both acute and chronic conditions, a heavy toll is exacted of the benign appendix by reason of its close affiliation with the right ureter. There are classical cases so typical of the appendix and also of the ureter, that one cannot be easily misled. I wish, however, to stress some of the baffling features which may be encountered by giving a brief recital of the salient points from a few case histories.

In a consideration of acute conditions, it must first be borne in mind that one of these tubular structures, the ureter, is extra-peritoneal, while the other, the appendix, is intra-peritoneal. Consequently, if the lesion be in the ureter, even though the pain be great and the elevation of temperature marked, two of the cardinal symptoms of serious intra-abdominal mischief, *viz.*, muscular rigidity and pronounced increase of pulse-rate, will not be conspicuous. The defensive, board-like spasm of the flat muscles of the abdomen, as an expression of resentment to peritoneal insult is well known to all; yet the finer degrees of such expression will often escape detection because of the rough tactics employed. The gentler palpation, the feather touch, are capable of conveying most valuable information. Furthermore, the very high temperatures, 103, 104 or 105° F., point, as a rule, not to the appendix, but to the ureter and pelvis of the kidney; provided, always, that a pneumonic condition of the lower lobe of the right lung can be definitely excluded.

#### CASE REPORTS

CASE I.—A corpulent man of forty was suddenly seized with violent loin pain, practically no nausea and no vomiting, no temperature, a normal pulse and no abdominal rigidity or tenderness. The history revealed the passage of a renal calculus some seven years previous and the urine showing in the present attack many red blood and pus cells. Forty-eight hours after onset, feeling much better, he left his bed, exerted himself somewhat, and had a sharp return of pain. When again seen on the fourth day of his illness, the temperature was 102 F., pulse 115, leucocytes 18,000, no tenderness over the abdomen proper, but marked tenderness in the right loin and just above the highest point of iliac crest. The urinary findings were not now so marked, no blood cells and only an occasional pus cell.



## CORRESPONDENCE

The diagnosis was now fairly clear; not an ureteral stone, as was first concluded, but a ruptured retrocæcal appendix as was subsequently revealed by operation.

CASE II.—An elderly woman of sixty-four, first seen twelve days after onset of present trouble. At no time had she felt acutely ill and had been up and about most of this time. The history revealed many attacks of cystitis with a probable complicating pyelitis. Examination showed a rather large mass, not very tender, in the right kidney region and extending somewhat downward, temperature of 101.5 F., pulse 90, and leucocytes 16,000. The urine from the right kidney showed many pus and blood cells, the pyelogram was negative for renal stone or tumor and the barium enema revealed no tumor of the large bowel and no obstruction. Operation, under local anæsthesia, because of hypertension and cardiac involvement, displayed a high-lying appendix abscess, securely fortified by a large mass of omentum.

These cases well illustrate the acute rampages of the appendix masquerading under predominating urinary symptoms.

CASE III.—A young girl of twenty is suddenly seized at 5 A.M., at the end of a menstrual period, with severe pain in abdomen, some nausea, marked tenderness in right iliac fossa and presenting practically no rigidity of abdominal muscles. The temperature is 101.5 F., pulse 100, leucocytes 19,000, with 90 per cent. polymorphonuclears and the urine is pus and blood free. This was the fourth attack of a similar nature occurring over a period of one and one-half years. The attending physician had previously diagnosed an acute appendix. This opinion is concurred in, immediate operation is performed with the finding of a benign appendix and a normal peritoneal cavity. The catheterized urine, on the following day, shows many pus cells and cystoscopic studies after convalescence revealed a dense ureteral stricture 4 cm. above the bladder, with a complicating pyelitis.

Two points in this history are significant: The absence of rigidity and the appearance of the attack at the end of the menstrual period. Deaver (*Archives of Surgery*, Jan., 1923) holds that attacks of right-sided pain occurring at this time are suggestive of a chronic appendix. My experience in ureteral stricture work has led to the opposite conclusion; that is to say, attacks of pain coming on during, or at the end of, a menstrual period serve to incriminate the ureter and to eliminate the appendix.

CASE IV.—A young married woman of twenty-three is taken acutely ill with severe abdominal pain, nausea, vomiting, temperature of 102 F. and exquisite tenderness over right iliac fossa. So clear seems this diagnosis that she is immediately rushed to the hospital and sectioned forthwith. A normal appendix and a normal peritoneal cavity are found. Further post-operative studies reveal a blood laden with plasmodia malariae, a urine with blood and pus and feces containing many hookworms. Convalescence is uneventful and the patient leaves the hospital on the eighth day. On the tenth day, she is again seized with agonizing pain and shortly thereafter passes an irregular, jagged calculus per urethram.

The average acute abdomen will permit of sufficient time for a study of the blood, the urine and possibly an X-ray. However, in the face of stormy symptoms, too much time is not to be consumed in scientific speculation. The fulminating appendix brooks no delay; better, by far, to remove more benign appendices than, by tardy tactics, to permit one malignant one to have full sway. So long as man continues to harbor this vestigial structure within his abdomen, just so long will these acute tragedies continue to confront the surgeon.

## CORRESPONDENCE

What constitutes a chronic appendix? Many pathologists deny the existence of chronic appendicitis, interpreting surgical chronic appendices as healed or healing lesions, the result of previous infectious processes. Codman, in a carefully studied series of ninety-eight operated cases of chronic appendicitis, found pathologic evidence of disease within the appendix in only sixty-one, and of these, fifty had definite histories of one or more classical acute attacks. Deaver, in analyzing five hundred operated cases of chronic appendicitis, states that there were twenty-seven different varieties of these chronic appendices as reported back to the surgeons from the laboratory. Robert T. Morris would have us believe that the appendix, because of its vestigial nature, is peculiarly prone to involutinal changes with connective-tissue formation, and thus becomes a perpetual source of irritation to the ganglia of the sympathetic nervous system. He describes, as diagnostic of chronic appendicitis: tenderness, located, not over McBurney's point, but over a point about one and one-half inches to the right and one inch below the navel, which point is from one to three inches from the classical McBurney's point. This point is an important one and should always be carefully palpated, for the reason that it defines the spot where the right ureter crosses the pelvic brim; consequently, marked tenderness here reflects, as a rule, not upon the appendix, but the ureter, as the more likely source of the trouble.

It matters but little what the pathologist may or may not have to say; the trained surgeon has learned to recognize the gross, macroscopic battle-scars inflicted upon an appendix which has previously been the seat of definite infection, the manifestations of which are to be seen in (a) pronounced peritoneal adhesions; (b) sharp kinking; (c) definite stricture of lumen, with consequent damming back of contents; (d) hardened fecal concretions. The mal-placed, ill-rotated or retrocaecal type, because of these congenital handicaps, will usually show one or more of the above features. When, therefore, the surgeon encounters, at operation, such an appendix, and when the carefully studied history substantiates the clinical findings, he may be more sure of his ground in promising relief. But if, on the other hand, none of these comforting manifestations are present, but the impeached appendix is found floating hither and thither within the cavity, it would be well for him to look further for the cause of the complaint.

JAMES N. BAKER, M.D.,  
*Montgomery, Ala.*

### To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

### ANNALS of SURGERY

227-231 S. 6th Street  
Philadelphia, Penna.

**Retarded Convalescence**

**Pre-Tuberculosis**

**Neurasthenia**

**Relapse**

**can often be avoided through the  
judicious use of a building and  
vitalizing factor.**

# **Fellows' Syrup of Hypophosphites**

*has been acknowledged for over Sixty Years  
as the Standard Preparation of its kind.*

**HAVE YOU TRIED IT?**

---

*Samples and literature on request*

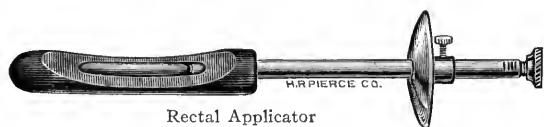
---

**FELLOWS MEDICAL MANUFACTURING COMPANY, Inc.**  
**26 Christopher Street, New York, N.Y., U.S.A.**

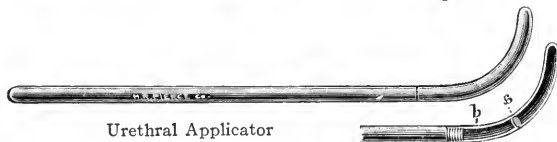
# SET OF APPLICATORS FOR Radium Treatment of the Prostate

(Hypertrophy and other Conditions)

AS DEVELOPED IN THE HAHNEMANN HOSPITAL, PHILADELPHIA



Rectal Applicator



Urethral Applicator

IN THEIR improved form these instruments are made entirely of metal, the rectal applicator being mainly of lead, which protects the tissues except where the silver capsule is exposed. A finger of a rubber glove pulled over this portion of the applicator and securely tied prevents secondary radiation.

The Urethral applicator is made of brass or silver tubing, as preferred, shaped to fit the prostatic urethra, being 1 mm. or less in thickness in the part containing the radium. It is used after the rectal applicator, for a "cross-fire" treatment, completing the radiumization of the affected parts.

This applicator also should be covered with thin rubber.

The physicians of the Hahnemann Hospital, who have developed this treatment, have had remarkable success in the relief of prostatic diseases by its use.

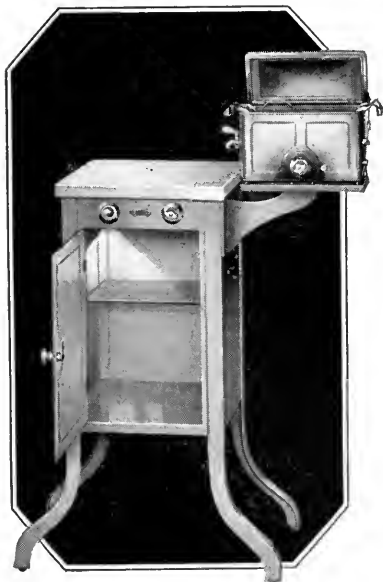
Price, \$26.00 for the Set

## HARVEY R. PIERCE COMPANY

Surgical Instruments

128 SOUTH NINETEENTH STREET

PHILADELPHIA



## WITH YOUR REPUTATION

### At Stake Can You Afford to Use Anything Other Than the Best?

The "PELTON" is the BEST Sterilizer possible.

If it were possible to build one any better, that is the way all "PELTON" Sterilizers would be made.

The "PELTON" is an Indestructible Sterilizer and includes every known improvement and convenience for the operator.

The original cost of the "PELTON" Sterilizer is a trifle more than most others, but the *final* cost is considerably less.

Ask Your Dealer or Write to Us for Folder.

"PELTON INDESTRUCTIBLE STERILIZERS"

## THE PELTON & CRANE CO.

632 Harper Avenue

DETROIT

MICHIGAN

## He Has Two Good Legs BOTH MADE BY MARKS



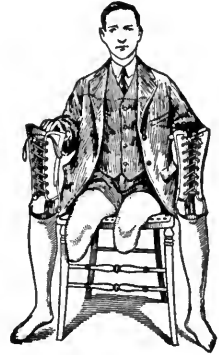
Although a man may lose both his legs, he is not necessarily helpless. By using artificial legs of MARKS PATENT he can be restored to usefulness. One engraving is from a photograph of a man ascending a ladder. He has two artificial legs substituting his natural ones. With MARKS PATENT Rubber Feet with Spring Mattress he can ascend or descend a ladder, balance himself on the rungs, and have his hands at liberty. He can work at a bench and earn good wages. He can walk and mingle with persons without betraying his loss; in fact, he is restored to himself for all practical purposes.

With the old method of complicated ankle joints, these results could not be so thoroughly attained.

Over 54,000 made and sent to all parts of the world.

Purchased by the United States Government and many Foreign Governments.

Send for MANUAL OF ARTIFICIAL LIMBS, containing 384 pages, with 674 cuts. Instructions are given how to take measurements and obtain artificial limbs without leaving home.

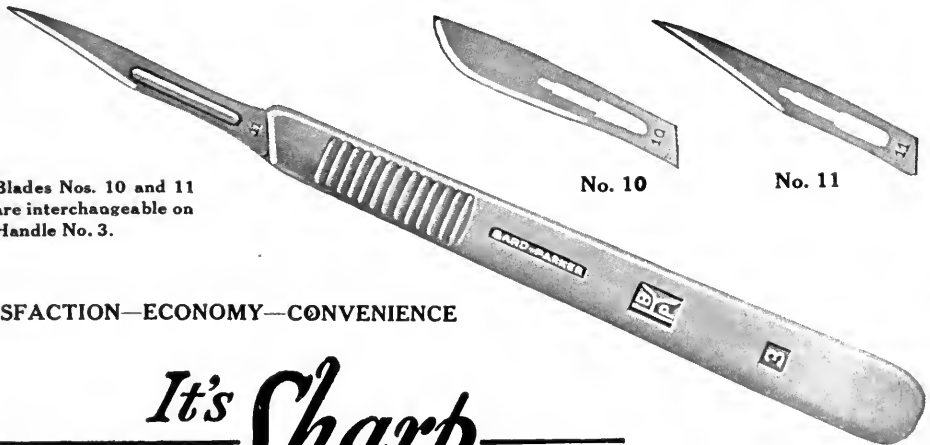


### A. A. MARKS

Established 68 Years

696-702 Broadway, NEW YORK, U. S. A.

## *It's Sharp* BARD-PARKER KNIFE *It's Sharp*



Blades Nos. 10 and 11  
are interchangeable on  
Handle No. 3.

No. 10

No. 11

No. 3

SATISFACTION—ECONOMY—CONVENIENCE

*It's Sharp*

Complete Circular on Request. ASK YOUR DEALER.

BARD-PARKER CO., INC., 37 E. Twenty-eighth St., NEW YORK

# LOESER'S INTRAVENOUS SOLUTIONS



## CONFIDENCE

The confidence of the profession in Loeser's Intravenous Solutions is so significant that it can scarcely be stressed too often.

Confidence born of years of trial and experience is the foundation of the reputation of Loeser's Intravenous Solutions as "The Standard."

This confidence has been earned by earnest untiring effort to maintain the highest standards of pharmaceutical accuracy and uniformity.

## LOESER'S INTRAVENOUS SOLUTIONS "The Standard"

Controlled by chemical, physical and animal tests.

*Clinical Reports, Reprints, Price List and "The Journal of Intravenous Therapy" Will be Sent to any Physician on Request*

### New York Intravenous Laboratory

100 West 21st Street, New York, N. Y.

*Producing Ethical Intravenous Solutions  
for the Medical Profession Exclusively.*



## INDEX TO ADVERTISERS

(Continued on page 6)

SURGICAL INSTRUMENTS		PAGE
Bard-Parker Co. . . . .		3
Harvey R. Pierce Co. . . . .		2
Katherine L. Storm, M.D. . . . .		22
Victor X-Ray Corporation . . . . .		14
Precision Thermometer & Instrument Co. . . . .		17
MacGregor Instrument Co. . . . .		21
RADIUM		
Radium Company of Colorado, Inc. . . . .		5
The Radium Emanation Corp. . . . .		15
MISCELLANEOUS		
Antidolor Mfg. Co. . . . .		20
George R. Fuller Co. . . . .		21
Geo. W. Brady & Co. . . . .		21
A. A. Marks . . . . .		3
The Vitrolite Co. . . . .		11
FOOD PRODUCTS		
Valentine Meat Juice Co. . . . .		Cover
HOTELS		
The Martinique . . . . .		22
Chalfonte Haddon Hall . . . . .		24
Hotel Morton . . . . .		22
Santa Rita Springs . . . . .		23
STERILIZERS		
Wilmot Castle Co. . . . .		9
The Pelton and Crane Company . . . . .		2
Castle Co. . . . .		9
The Prometheus Electric Company . . . . .		15
X-RAY PLATES AND APPARATUS		
Eastman Kodak Co. . . . .		19



*The Mark of a Complete and Careful Radium Therapeutic Service*

## So The Doctor May Know

Such statements by these highly competent authors, cannot be lightly overlooked

"We believe, however, that radium is a very valuable adjunct to operation in dealing with this disease (Teratoma Testis). The type most often seen and most malignant, the embryonal, is the most sensitive to destruction by radium." BENJ. S. BARRINGER, M.D. and ARCHIE L. DEAN, JR., M.D., New York City. *Journal of the American Medical Association*.

"The wave of opinion today, among scientific research workers, is that toxic goiter is not a surgical disease." The conclusion is that radium is the treatment of choice. R. E. LOUCKS, M.D., Detroit. *American Journal of Roentgenology*.

"Results of irradiation in cancer of the cervix may remove this class of cases from the surgical field, although we have not yet completely yielded this point." John G. Clark, M.D., and Floyd E. Keene, M.D., Philadelphia, *American Journal of Roentgenology*.

*The Medical Department has many thousands of reprints or abstracts on file and can supply not a little information to those interested.*

*The Radium Therapist is OUR publication.*

*Sample copies will be sent upon request.*

**THE RADIUM COMPANY OF COLORADO**  
RADIUM BUILDING, DENVER, U. S. A.

BRANCH OFFICES

SAN FRANCISCO  
592 MARKET ST.

CHICAGO  
853 PEOPLES GAS BUILDING

NEW YORK  
244 MADISON AVE.

PARIS  
118 AVENUE DES CHAMPS ELYSEES

## STOVAINE "BILLON"

(Benzoyl-Dimethylaminomethylpropanol  
Hydrochloride)

NON Habit Forming Anesthetic  
Sterilized Ampoules for Hypodermic Injections

- A. Dentistry and Minor Surgery  
Ampoules 2 cc. 1%—"Sauvez"  
Box of 12 ampoules **\$1.05**
- B. Local Anesthesia in General Surgery  
Ampoules 10 cc. ½%—"Reclus"  
Per ampoule **\$.40**
- C. Spinal Anesthesia  
(a) Ampoules ¾ cc. 10% "Tuffier"  
Box of 12 ampoules **\$1.65**  
(b) Ampoules 2 cc. 5% "Barker"  
Box of 6 ampoules **\$2.25**
- Powder in original bottles of  
5, 10, 25, 50 and 100 grams

## SONÉRYL "POULENC"

(Butyl-Ethyl-Malonyl-Urea)

A New Hypnotic and Analgesic  
NON Habit Forming

A Valuable Addition to the Symptomatic  
Therapeutics of Pain Insomnia

Strikingly superior action of  
slight toxicity

Powder in original vials of  
10, 25, 50 and 100 grams

Tablets (10 cgm) per tube of 20  
—**\$.75**

**PRODUCED BY ETAB. POULENC FRÈRES, PARIS, FRANCE**

For literature, etc. address.

**GEORGE J. WALLAU, Inc. 6 CLIFF ST. NEW YORK, N. Y.**

### INDEX TO ADVERTISERS, CONTINUED FROM PAGE 4

PAGE

#### PHARMACEUTICAL SUPPLIES

Lambert Pharmacal Co. . . . .	17
H. A. Metz Laboratories . . . . .	Cover
G. H. Sherman, M.D. . . . .	10
Schering & Glatz . . . . .	18
Fellows Medical Mfg. Co. . . . .	1
Purdue Frederick Co. . . . .	21
New York Intravenous Laboratory . . . . .	4
Parke, Davis & Co. . . . .	12
Farwell & Rhines . . . . .	21
Physicians Supply Co. . . . .	10
Parmele Pharmacal Co. . . . .	Cover
Armour & Co. . . . .	Back Cover
H. K. Mulford Company . . . . .	9
G. J. Wallau . . . . .	6
Abbott Laboratories . . . . .	18
Savory & Moore, Ltd. . . . .	7
Smith, Kline & French Co. . . . .	7
Sharp & Dohme . . . . .	13
The Cilkloid Company . . . . .	Cover

#### LIGATURES

Davis & Geck . . . . .	16
C. DeWitt Lukens Co. . . . .	16

#### SANITARIUMS

Battle Creek Sanitarium . . . . .	23
F. H. Barnes Sanitarium . . . . .	21



THE SAFE ANÆSTHETIC

# ETHANESAL

Ethanesal was prepared as the result of prolonged research work by Dr. Mackenzie Wallis of St. Bartholomew's Hospital, London. It consists of an absolutely pure ether in which are dissolved Ethylene and certain of the higher Ketones. The mercaptans, aldehydes, peroxides, etc., which cause the unpleasant smell, taste, and vomiting experienced with ordinary ether, have all been removed. Its advantages are:

- (1) It is practically non-toxic.
- (2) It is not irritating to the air passages.
- (3) It does not cause after taste or smell.
- (4) It can be given with safety where cardiac and respiratory disturbances exist.

Produced by

**SAVORY & MOORE, Ltd., London**

FOR LITERATURE, ETC., ADDRESS

**E. FOUGERA & CO., Inc., American Agents, 90, 92 Beekman St., New York**

## *The Nutrition of Nerves*

The glycerophosphates exert a selective influence on the nutrition of nerves, increase general metabolism, influence the exchange of nitrogen, and facilitate the utilization of sulphur compounds.

## **ESKAY'S NEURO PHOSPHATES**

exhibits the glycerophosphates in a most efficient form.

**SMITH, KLINE & FRENCH CO.**

**105-115 North 5<sup>th</sup> St., Philadelphia, Pa.**

Established 1841

Manufacturers of *Eskay's Food*

# NEW LIPPINCOTT TEXTS

## Howard—PRACTICE OF SURGERY

This practice covers the subject as taught and practiced at the celebrated London Hospital—a complete and thoroughly practical volume by RUSSELL HOWARD. 1275 Pages. 8 Colored Plates. 542 Text Illustrations. Third Edition. \$7.00

## Feer—PEDIATRICS

A celebrated text-book by nine European and seventeen American Pediatricians. No similar one-volume work appears in our language. A distinct advantage is the concise treatment of the subject matter. Arrangement is such that no time is lost in referring to any one descriptive passage. Etiology, Pathology, Symptomology treatment are all complete. Discussions of individual diseased conditions are absolutely dependable, and the therapeutic measures advised are in line with the most recent accepted usage. 917 Pages. 262 Illustrations. \$8.50.

## Fuchs—OPHTHALMOLOGY

Entirely rewritten and rearranged in a logical order so that the relations between the separate parts of the subject shall be made most clear. Changes are so numerous as to occur practically on every page. Translators had the benefit of consultation with Dr. Fuchs in a comparison with a thoroughly revised thirteenth German edition. Chapters on Refraction are entirely remodeled and much augmented. It is the most thoroughly revised edition of FUCHS' celebrated work ever issued. 997 Pages. 455 Illustrations. Seventh Edition. \$9.00.

## Heisler—DISSECTOR

Of service not only to the dissector and advanced student, but to the practitioner who may desire a brief exposition of the facts of anatomy from the topographical point of view. In the references throughout the text to the work of dissection, though intended for the convenience of the student, we have to emphasize the relationship of structures. 792 Pages. 366 Illustrations, of which 225 are in color. Third Edition. English, \$6.50.

## Emerson—CLINICAL DIAGNOSIS

An entirely new book with the same title and by the same author of a most successful work of ten years ago. As in previous editions, it is not merely a manual for laboratory workers, but is intended especially for medical students and practitioners of Internal Medicine. It has new sections on Serology, Bacteriology, Chemistry of the Blood and of the Spinal Fluid. 726 Pages. 156 Illustrations. Fifth Edition, entirely rewritten and reset. \$7.50.

## Flagg—ANAESTHESIA

This well-known text-book has been carefully brought up to date with deletions, corrections and additions. With a complete description of the Haemoximeter which affords a simple clinical means of reading the oxygen content of the blood. 371 Pages. 136 Illustrations. Colored Frontispiece. Third edition revised. \$4.50.

## Keen—I BELIEVE IN GOD AND IN EVOLUTION

This remarkable book by a remarkable surgeon and author gives a ringing answer to a vital question. With brilliant logic, he answers the perplexing questions relating to the origin of man and shows that Darwinism and Evolution are wholly independent of each other. 12 mo. 100 Pages. \$1.00.

## McDonald—ESSENTIALS OF SURGERY

This unique text for nurses does not cover surgical technic. It is written in the belief that a nurse can more intelligently assist in the care of her patients if she has a reasonable conception of the conditions present and of the indications to be met. It covers the general principles of surgical diseases and the pathological changes which result—more important surgical lesions involving special regions of the body, including gynecological, surgical lesions, all simply presented. 265 Pages. 49 Illustrations. Second Edition. \$2.50.

## Ely—INFLAMMATION IN BONES AND JOINTS

A distinctly personal book, based on the results of original research and work in the pathological laboratory and co-relation of this work with clinical findings. A truly practical and delightfully written book of a very important subject by LEONARD W. ELY, Stanford University. 426 Pages. 144 Illustrations. \$6.00.

## Moore—NUTRITION OF MOTHER AND CHILD

Emphasis has been placed upon breast feeding, vitamins and the mineral content of the diet. In the chapter on breast feeding, nothing is included which has not been tested and proven of practical value. Written by C. ULYSSES MOORE, University of Oregon, with menus and recipes by MYRTLE JOSEPHINE FERGUSON, Iowa State College. 227 Pages. \$2.00.

## Broadhurst—HOW WE RESIST DISEASE

Designed as a brief introduction to the field of immunity. Prepared for nurses who are interested in so many practical applications of the subject. The work covers in a general way, the most important preventive and curative practices. Wherever possible, general directions of process regarding actions, etc. have been used. With a glossary. 248 Pages. 138 Illustrations. 4 Colored Plates.

## Bliss and Olive—PHYSICS AND CHEMISTRY FOR NURSES

It is completely revised and rewritten and conforms to the Standard Curriculum of the National League of Nursing Education. The original authors have had the advantage of the collaboration of FRANCES W. WHITE—ETHEL JOHNS—SR. MARY ALMA—ALICE L. LAKE.—STELLA ACKLEY—ADELAIDE M. LEFFINGWELL. It covers the special applications of physics and chemistry to nursing, carefully limiting the material to the brief time allotted to the course in the Standard Curriculum. There has been a considerable elimination of material from other editions and the work stresses the importance of suitable laboratory work of practical value. Third Edition. 299 Pages. 70 Illustrations. \$2.50.

**J. B. LIPPINCOTT COMPANY**  
PUBLISHERS  
PHILADELPHIA

# DAVIS & GECK, INC.

*Surgical Sutures Exclusively*

KALMERID  
REG. U.S. PAT. OFF.

211-221 Duffield Street - Brooklyn, N. Y., U. S. A.



## Claustro-Thermal Catgut Aseptic

**C**LAUSTRO-THERMAL, the improved method of heat sterilization, consists in applying the heat after closure of the tubes, thus avoiding all the chances of accidental contamination.<sup>1</sup> Sterilization by this positive method is made feasible by use of toluol as the tubing fluid, instead of the unstable chloroform.<sup>2</sup>

No other mode of sterilization so completely fulfills the exacting requirements for the production of ideal sutures as does the Claustro-Thermal method. It preserves the natural physical characteristics of the strands, while the destruction of all bacterial life is absolutely assured.<sup>11</sup>

Claustro-Thermal catgut is aseptic though not germicidal. Not being impregnated with any bactericidal substance, it is inert in the tissues, exerting no inhibitive action.

These sutures are boilable. The tubes even may be autoclaved up to 30 pounds pressure for sterilizing their exterior preliminary to use. The heat sterilization procedure is described on the following page.

### VARIETIES OF CLAUSTRO-THERMAL CATGUT

Each Tube Contains Approximately Sixty Inches

Plain Catgut.....	No. 105
10-Day Chromic Catgut.....	No. 125
20-Day Chromic Catgut.....	No. 145
40-Day Chromic Catgut.....	No. 185

SIZES: 000...00...0...1...2...3...4

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

A wholesale discount of 25% is allowed on one gross or more (\$27 net per gross); carriage paid



Kalmerid catgut imbedded in agar infected with *Staphylococcus pyogenes aureus*



Iodized catgut imbedded in the same medium. Note the proximity of colonies

## Kalmerid Catgut Antiseptic

**K**ALMERID CATGUT is an improved germicidal suture superseding iodized catgut.<sup>3</sup> It is not only sterile, but, being impregnated with potassium-mercuric-iodide—a double iodine compound—the sutures exert a local bactericidal action in the tissues.<sup>4</sup> It differs from the Claustro-Thermal catgut only in this respect.<sup>11</sup>

The serious disadvantages of iodized catgut—deterioration, irritation, and impaired tensile strength—have been overcome through the use of potassium-mercuric-iodide instead of iodine. Unlike iodine, it does not break down under the influence of light or heat, it is chemically stable, and it is neither toxic nor irritating to the tissues. It interferes in no way with the absorption of the sutures, and is not precipitated by the proteins of the body fluids.<sup>5,6,7</sup>

These sutures are boilable. The tubes even may be autoclaved up to 30 pounds pressure for sterilizing their exterior preliminary to use. The heat sterilization procedure is described on the following page.

### VARIETIES OF KALMERID CATGUT

Each Tube Contains Approximately Sixty Inches

Plain Catgut.....	Boilable Grade.....	No. 1205
10-Day Chromic.....	Boilable Grade.....	No. 1225
20-Day Chromic.....	Boilable Grade.....	No. 1245
40-Day Chromic.....	Boilable Grade.....	No. 1285

SIZES: 000...00...0...1...2...3...4

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

A wholesale discount of 25% is allowed on one gross or more (\$27 net per gross); carriage paid

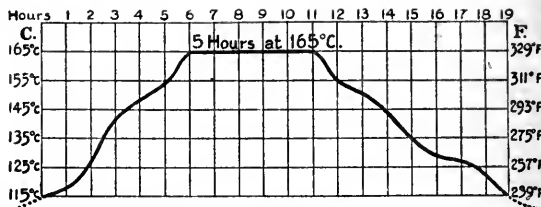
Kalmerid catgut is made also in an extra flexible grade, which is non-boilable, and which is described on the following page.

### GERMICIDAL EFFICIENCY AS COMPARED WITH IODIZED CATGUT

The marked inhibitory power of Kalmerid catgut, as compared with iodized sutures, is strikingly shown in these reproductions of culture plates. The lighter areas about the imbedded sutures represent zones of no bacterial growth, while the darker portions are masses of *Staphylococcus* colonies. It is evident that Kalmerid sutures exert in the tissues a far greater antiseptic action than do the usual iodized sutures.<sup>4,7,11</sup>

## Method of Sterilization

**B**OTH Claustro-Thermal and the boilable grade of Kalmerid catgut, described on preceding page, are subjected to the same sterilizing procedure: the sealed tubes are submerged in a bath of cumol and there exposed for five hours to the rigorous temperature of 165° C. (329° F.).<sup>1</sup> It is obvious that sterility is absolutely assured. Rigid bacteriologic control is maintained.



### Kalmerid Catgut—(Non-Boilable Grade)

#### Extra Flexible

**T**HE NON-BOILABLE grade of Kalmerid catgut differs from the boilable variety described on the preceding page in that it possesses extreme flexibility—a characteristic sometimes desired by surgeons accustomed to the use of iodized catgut.<sup>7</sup> It is impregnated with potassium-mercuric-iodide, causing the sutures to exert a local bactericidal action in the tissues.<sup>11</sup>

Potassium-mercuric-iodide is the double salt of iodine and mercury,<sup>6</sup> the chemical formula of which is  $HgI_2 \cdot 2KI$ . Through its use the serious disadvantages of iodized catgut—deterioration, irritation, and impaired tensile strength—have been overcome.<sup>8</sup> It is one of the most active germicides known, exerting a killing action on bacteria about ten times greater than that of iodine.<sup>4,5</sup> Physiologically it is bland and is entirely compatible with the tissues, not being precipitated by the proteins of the body fluids.

#### VARIETIES OF THE NON-BOILABLE GRADE OF KALMERID CATGUT

Each Tube Contains Approximately Sixty Inches

Plain Catgut.....	Non-Boilable Grade....	No. 1405
10-Day Chromic....	Non-Boilable Grade....	No. 1425
20-Day Chromic....	Non-Boilable Grade....	No. 1445
40-Day Chromic....	Non-Boilable Grade....	No. 1485

SIZES: 000...00...0...1...2...3...4

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

A wholesale discount of 25% is allowed on one gross or more (\$27 net per gross); carriage paid

### Kalmerid Kangaroo Tendons

#### Boilable - Non-Boilable

**K**ALMERID KANGAROO TENDONS are the sutures par excellence for those procedures in which post-operative tension is extreme, or long continued apposition necessary, such as in herniotomy, and in tendon or bone suturing. They are not only sterile, but, in addition, are impregnated with potassium-mercuric-iodide, as in Kalmerid catgut, which enables them to exert a local bactericidal action in the tissues.<sup>3,4,11</sup>

They are genuine kangaroo tendons; they are smooth, straight, of uniform contour, and possess a tensile strength about twice that of catgut.

The tendons are chromicized, and so accurately is the process regulated that each size will maintain apposition in fascia or in tendon for approximately thirty days.<sup>8</sup>

Kalmerid kangaroo tendons are prepared in two grades—boilable and non-boilable. The latter are extremely pliable.<sup>7</sup>

#### VARIETIES AND SIZES

Non-Boilable are Product No. 370  
The Boilable are Product No. 380

Each Tube Contains One Tendon  
Lengths Vary From 12 to 20 Inches

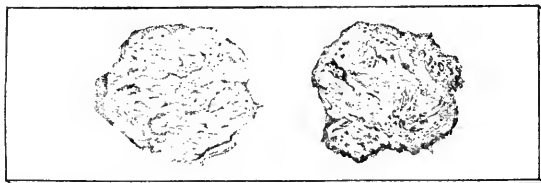
SIZES: 0...2...4...6...8...16...24

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

A wholesale discount of 25% is allowed on one gross or more (\$27 net per gross); carriage paid

#### THE PERMEATION OF KALMERID SUTURES BY POTASSIUM-MERCURIC-IODIDE



The lighter shaded specimen is a cross section of a strand of plain Kalmerid catgut, highly magnified.

The darker shaded specimen is a cross section of the same strand reacted upon by ammonium sulphid to precipitate the mercuric element.

The uniform color throughout the darker section shows the thorough permeation by the potassium-mercuric-iodide, the equable distribution of which assures a supply of this germicidal substance in the tissues until the suture is entirely absorbed.

## General Qualities of All D & G Sutures

**T**HE SALIENT FEATURES of all varieties of D & G Sutures are compatibility with the tissues, perfect absorbability, maximum tensile strength,

accuracy of sizes, flexibility, and absolute sterility. They are unaffected by age or light, or by extremes of climatic temperatures.

## Various Non-Absorbable Sutures

Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
350..Celluloid-Linen Thread..60 Inches....	000, 00, 0	
360..Horsehair.....	4 28-In. Sutures.....	00
390..Plain Silkworm Gut.4 14-In. Sutures...	00, 0, 1	
400..Black Silkworm Gut.4 14-In. Sutures...	00, 0, 1	
450..White Twisted Silk....60 In.....	000, 00, 0, 1, 2, 3	
460..Black Twisted Silk....60 In.....	000, 0, 2	
480..White Braided Silk....60 In.....	00, 0, 2, 4	
490..Black Braided Silk....60 In.....	00, 1, 4	

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

Wholesale discount of 25% allowed on gross or more; carriage paid

## Sutures For Minor Surgery

Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
802..Plain Catgut.....	20 In.....	00, 0, 1, 2, 3
812..10-Day Chromic Catgut..20 In.....	00, 0, 1, 2, 3	
822..20-Day Chromic Catgut..20 In.....	00, 0, 1, 2, 3	
862..Horsehair.....	2 28-In. Sutures.....	00
872..Plain Silkworm Gut.2 14-In. Sutures.....	0	
882..White Twisted Silk.....	20 In.....	000, 0, 2

In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$1.50

Wholesale discount of 25% allowed on gross or more; carriage paid

## Sutures With Needles

Heat Sterilized After Closure of Tubes—Boilable

Product No.	Approximate Quantity in Each Tube	Standard Sizes
904..Plain Catgut.....	20 In.....	00, 0, 1, 2, 3
914..10-Day Chromic Catgut..20 In.....	00, 0, 1, 2, 3	
924..20-Day Chromic Catgut..20 In.....	00, 0, 1, 2, 3	
964..Horsehair.....	2 28-In. Sutures.....	00
974..Plain Silkworm Gut.2 14-In. Sutures.....	0	
984..White Twisted Silk.....	20 In.....	000, 0, 2



EMERGENCY NEEDLE  
For Skin, Muscle, or Tendon

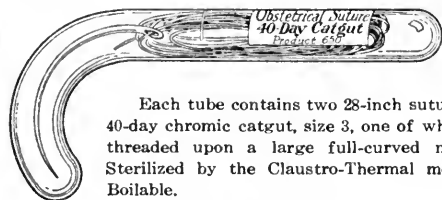
In packages of twelve tubes of one kind and size

List Price per dozen tubes (in U. S. A.).....\$3

Wholesale discount of 25% allowed on gross or more; carriage paid

## Obstetrical Sutures

For Immediate Repair of Perineal Lacerations



Each tube contains two 28-inch sutures of 40-day chromic catgut, size 3, one of which is threaded upon a large full-curved needle. Sterilized by the Claustro-Thermal method. Boilable.

One tube in a package

Product No. 650. List Price per tube.....\$ .35

Wholesale discount of 25% allowed on gross or more; carriage paid

## Circumcision Sutures

Heat Sterilized After Closure of Tubes—Boilable



Each tube contains a 30-inch suture of plain catgut, size 00, threaded upon a small full-curved needle.

In packages of twelve tubes

Product No. 600. List Price per dozen tubes.....\$3

Wholesale discount of 25% allowed on gross or more; carriage paid

## Umbilical Tape

Heat Sterilized After Closure of Tubes—Boilable



Each tube contains two 12-inch ligatures of a specially woven flat tape one-eighth inch wide

In packages of twelve tubes

Product No. 892. List Price per dozen tubes....\$1.50

Wholesale discount of 25% allowed on gross or more; carriage paid

## Standard Sizes For All Sutures

000	IN conformity with the long
00	recognized need for a
0	unified system of sizes, the
1	standard scale of catgut sizes
2	now embraces all sutures, in-
3	cluding silk, horsehair, silk-
4	worm gut, celluloid-linen
6	thread, and kangaroo tendons
8	(only the latter occurring in
16	sizes 6, 8, 16, and 24).
24	

## Bibliography

- 1 AN IMPROVED METHOD FOR STERILIZING CATGUT SUTURES. By Cassius H. Watson, B.S., M.D. Surg., Gyn. & Obstet., Sept. 1919.
- 2 TOLUOL: ITS ADVANTAGES OVER CHLOROFORM OR ALCOHOL AS A STORING FLUID FOR SURGICAL CATGUT. By Allen Rogers, Ph. D. Annals of Surgery, March 1916.
- 3 AN IMPROVED SUBSTITUTE FOR IODIZED CATGUT SUTURES. By Cassius H. Watson, B.S., M.D. Surg., Gyn. & Obstet., Jan. 1916.
- 4 AN IMPROVED SUBSTITUTE FOR IODIZED CATGUT SUTURES—II. BACTERIOLOGICAL TESTS. By Cassius H. Watson, B.S., M.D. Surg., Gyn. & Obstet., Nov. 1916.
- 5 THE GERMICIDAL VALUE OF POTASSIUM MERCURIC IODIDE. By Douglas Macfarlan, M. D. Amer. Jour. Med. Sci., April 1920.
- 6 POTASSIUM-MERCURIC IODIDE—ITS NATURE, ACTION, AND USES. Davis & Geck, Inc., 1920.
- 7 KALMERID—AN IMPROVED CATGUT TO SUPERSEDE IODIZED SUTURES. Davis & Geck, Inc., 1916.
- 8 THE ABSORPTION AND TENSILE STRENGTH OF CERTAIN ABSORBABLE ANIMAL LIGATURES. By Gray Phillips, M.D. Jour. A. M. A., April 25, 1914.
- 9 CHROMICIZED CATGUT PREPARED TO RESIST ABSORPTION FOR DEFINITE PERIODS. Davis & Geck, Inc., 1916.
- 10 ABSORBABLE ANIMAL LIGATURES. By Thomas A. Berryhill, M. D., Medical Director, United States Navy. U. S. Naval Medical Bulletin, July 1913.
- 11 D&G SUTURES—A COMPLETE DESCRIPTION OF METHODS. 48 pages. Davis & Geck, Inc., 1923.

Reprints will be sent upon request

# VALUABLE ASSETS OF SURGERY



STANDARD PACKAGE  
Containing Twelve Tubes of One Kind and Size

## Discount

THE standard wholesale discount of 25% from list prices is accorded hospitals and surgeons on any quantity of sutures, of a kind or assorted, down to one gross. Under a gross the list prices are net.

D&G sutures are sold by practically all of the responsible dealers in surgical supplies, or may be obtained, carriage paid, direct from Davis & Geck, Inc.

Printed in U.S.A.



June Insert for  
ANNALS OF SURGERY  
Copyright 1923 D&G Inc.

# Hospital sterilizing safety

---at low cost

THE private surgery or clinic need the same positive sterilization that is demanded if goods are taken to a hospital for sterilization.

It is more satisfactory, however, and cheaper, to install Castle Sterilizers. They work with hospital certainty and last a life time. Ask for more details about the No. 2001 vertical autoclave and other combination outfits.

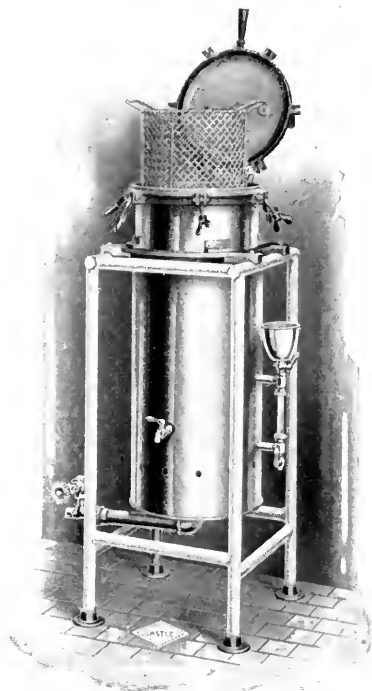


"Every clinic or surgery needs a good sterilizer."

## CASTLE

*Sterilizers for Physicians, Dentists and Hospitals*

WILMOT CASTLE CO., 1115 University Ave., Rochester, N. Y.



## Ideal Hay Fever Treatment

The 15-dose series of  
Mulford Pollen Extracts  
in ever-ready Hypo-Units



MULFORD HAY FEVER POLLEN EXTRACTS are the specific pollen proteins in refined form, accurately standardized in terms of pollen units.



56331

The MULFORD HYPO-UNIT package is the last word in convenience, safety and accuracy. Each Hypo-Unit contains one accurately measured dose, and is sterile and completely assembled, ready for instant use.

H. K. MULFORD COMPANY, PHILADELPHIA, U. S. A.

# Mulford

THE PIONEER BIOLOGICAL LABORATORIES

# DUODENAL BILIARY OUTFIT

DEvised AND USED BY DR. B. B. VINCENT LYON

Associate in Medicine — Jefferson Medical School; Chief of Clinic of Gastro-Enterological Dept. — Jefferson Hospital; Visiting Physician — Methodist Hospital

Lyon's Duodenal Biliary Outfit, for diagnosis and treatment of Cholecystitis, Choledochitis, and collection of Pancreatic and Biliary Secretions—consisting of:

One specially designed Metal Tip possessing obvious advantages for use on Gastric and Duodenal Tubes.

One Special Glass moulded Rubber Duodenal Tube, graduated, with Glass Connection.

One Double Neck reversed Valve Rubber Bulb, with Tubing and Clamp.

Three assorted size Bottles for Gall-bladder contents.

One 250 CC Glass Graduated.

One 1 oz. Glass Asbestos Packed Syringe.

One 300 CC Graduated Perculator with Metal Hanger, Tubing and Cut-off.

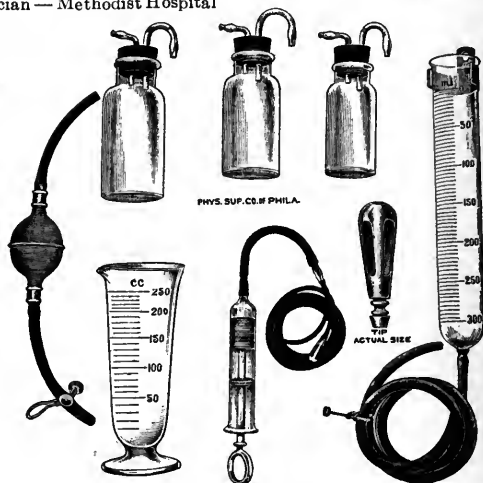
The Necessary Rubber Stoppers, Bent Glass Connecting Tubes, and Rubber Tubing to complete set.

The Syringe with Duodenal Tube and Special Lyon Tip can be used for the fractional examination of gastric duodenal contents—used also as a Duodenal Feeding Tube in case of Ulcer, Cancer of the Stomach, Dilatation of Stomach, Nervous Vomiting, certain diseases of Liver, and, after operation, on Stomach, or in any condition where food should not touch the Stomach.

**The above Outfit complete, \$12.00**

See Dr. Allen O. Whipple's article in May, 1921, issue Annals of Surgery.

*Nose, Throat and Ear Men write for new catalog.*



**THE PHYSICIANS SUPPLY CO. OF PHILA.**

Surgical Instruments, Hospital and Invalid Supplies

**N. W. Cor. 16th & Sansom St., Philadelphia**

**P**ULMONARY involvement is one of the most frequent and dangerous post-operative complications.

Extensive experience in the prophylaxis of respiratory disease has convinced us that the incident of these complications can be greatly reduced by prophylactic immunization.

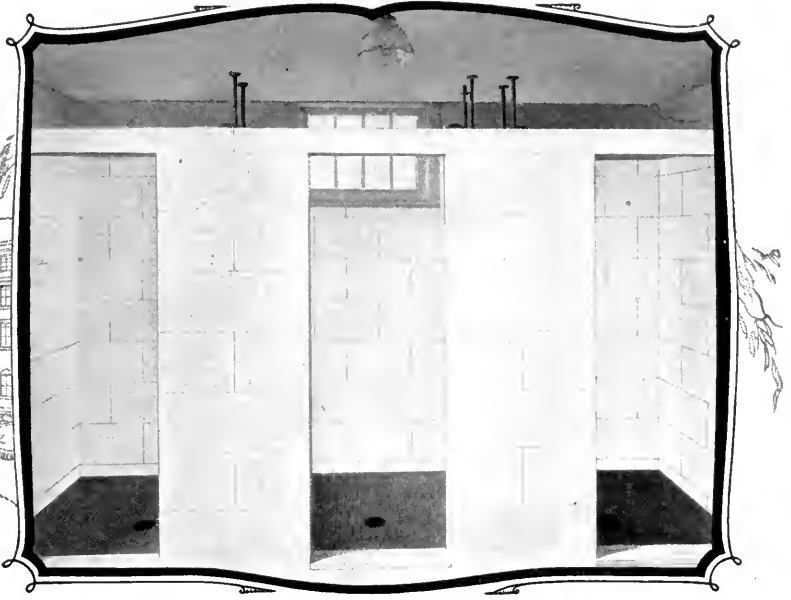
We will be pleased to co-operate with *Hospitals* and provide vaccines and technicians without obligation to demonstrate what can be accomplished in the prophylaxis of post-operative complication.

**Bacteriological Laboratories of G. H. SHERMAN, M.D., Detroit**

Address Dept. C.



The impression one gains on inspecting this shower room at the Ashland State Hospital, Ashland, Pa., is of exquisite cleanliness and perfect sanitation.



## The First Essential in Wall Surfacing

**T**O make the interior walls and wainscoting of a hospital perfectly sanitary and easily kept clean is the first essential. That's why Vitrolite is so generally used for hospital wall surfacing. It is impervious to germ life—affords no hiding place for infection—gives pitiless publicity to every spot or speck. It makes the work of cleaning easy, facilitates inspection and discourages slipshod cleaning work.

These same qualities which make Vitrolite the ideal slab material for the hospital are equally valuable wherever wall surfacing, toilet partitions, wainscoting and corridors are found in all institutional and residential buildings. The fact that it is stainproof, wearproof, changeless, instantly cleaned and reasonable in installation cost places it in a class by itself. Investigation of prominent installations in your own locality will satisfy you on all these points.

### Representative Installations of Vitrolite

Holyoke, Mass.  
Holyoke City Hospital—  
Nurses Home—Architect,  
Geo. Alderman

Detroit, Mich.  
Ford Hospital—Architects,  
Malcomson, Higginbotham  
& Palmer

Ashland, Pa.  
Ashland State Hospital—  
Architect, Louis L. Stockton.  
Henry C. Pelton, Associate

Evanston, Ill.  
Evanston Hospital

*List of installations gladly supplied to architects and institutional officials on request. Write for specification data and address of Vitrolite distributor in your city.*

### THE VITROLITE COMPANY

Dept. F-7, 133 West Washington Street, Chicago  
*Service Organizations in Principal Cities of America and Overseas*



## MERCUROSAL SUBJECTED TO PHYSIOLOGICAL TEST

**A**FTER every practicable chemical test has shown Mercurosal,\* the new anti-syphilitic mercury compound, to be satisfactory, this product is subjected to a test for toxicity on rabbits of standard weight, these animals having been found to yield more definite data than others.

Mercurosal in solution is introduced into the marginal vein of the rabbit's ear at a carefully controlled rate—very slowly depending on the size of the animal. The optimum rate of injection has been determined by numerous experiments, and is an important item in the test.

Our investigators will not

pass any batch of Mercurosal that will prove fatal to a 2- to 4-kilo rabbit in a dose of less than 40 to 80 milligrams. The standard is a minimum of 20 to 30 milligrams per kilo.

The margin of safety is impressive. Calculated on the basis of weight alone a toxic dose of Mercurosal for a man weighing 65 kilos (150 lbs.) would be 1.3 gms. or *13 times the recommended intravenous dose.*

By means of the chemical tests we determine the purity of Mercurosal, and from that might be judged its relative freedom from toxicity; nevertheless the physiologic toxicity test is invariably performed as an added precaution.



\*Disodiumhydroxymercurisalicycloxyacetate. Contains about 43.5% of mercury in organic combination. Relatively non-toxic and non-irritating. Adapted for intravenous and intramuscular administration in the treatment of syphilis.

### PARKE, DAVIS & COMPANY

Laboratories at Baltimore

## SHARP & DOHME

Ethical Products

CHEMISTS SINCE 1860

BRANCHES: Chicago—St. Louis—Atlanta—New Orleans—Philadelphia—Kansas City

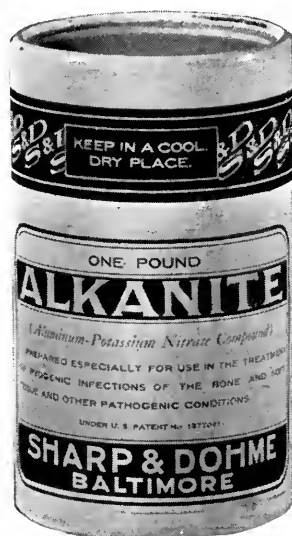
GENERAL OFFICES: NEW YORK CITY

The *worst* cases  
of Osteomyelitis  
are the *best* cases  
for ALKANITE

As an adjunct to  
good surgery  
“Alkanite” ranks  
with Dakin’s

In 1/4-lbs at \$1.50  
thru your druggist

# ALKANITE





## X-RAY FLUOROSCOPIC AND RADIOGRAPHIC DIAGNOSIS WITH A SINGLE UNIT

**I**N many roentgenological laboratories and general practitioners' offices a single unit is needed for fluoroscopic or radiographic diagnosis.

To meet this need the Victor Stabilized Fluoroscopic and Radiographic Unit has been designed. Its principal feature is the Victor-Kearsley Stabilizer, which is found only in Victor equipment and which automatically controls the tube current regardless of the fluctuations in line voltage. The result is that technique can be standardized and uniformly good radiographic results can be counted upon.

In addition there are such refinements as a circuit breaker for protecting opera-

tor, patient and apparatus; the auto-transformer control which permits the selection, through one lever, of any back-up spark from three to five inches; the high-tension, closed core, oil-immersed transformer; and the control stand with its long cable and its convenient on-and-off foot-switch, and its caster-mounting which makes movement in every part of a room possible.

The underlying principles of construction and operation have been established by Victor research, which is a sufficient guarantee that the Unit will meet the requirements of the general practitioner or the roentgenologist.

*A descriptive bulletin will be sent on request*

VICTOR X-RAY CORPORATION, Jackson Blvd. at Robey St., Chicago, Ill.  
*Sales Offices and Service Stations in All Principal Cities*



[ R A D O N ]

# RADIUM EMANATION

## AVAILABLE FOR THE FIRST TIME

RADIUM EMANATION is now available for the *first time* on short notice in any quantities or concentration desired.

RADIUM EMANATION is applicable to any therapy where radium salts are indicated.

RADIUM EMANATION may be put into containers of any desired shape, size and strength, permitting a flexibility impossible with radium salts.

RADIUM EMANATION implantation permits of a uniform distribution of greater intensity and makes possible the treatment of regions otherwise inaccessible.

*Special instruments, screens and applicators furnished as desired.*

*Shipments over reasonable distances practical.*

*Telephone and telegraphic orders given prompt attention.*

Our laboratories are under the direction of a highly skilled technical staff, qualified by long experience in the physics of Radium Emanation, insuring an accurate and comprehensive administration of our service.

The equipment used for the collection, purification, and measurement of Radium Emanation is the most modern and was especially designed by our consulting physicist, *William Duane, Ph.D., D.Sc., Prof. Bio-physics, Harvard.*

We will gladly send Dr. Duane's brochure, "*The Use of Radium Emanation in the Treatment of Disease*" on request, with any additional information you may ask for.

## THE RADIUM EMANATION CORPORATION

258 WEST 57th STREET

Telephone Circle 3649

NEW YORK CITY

[ R A D O N ]

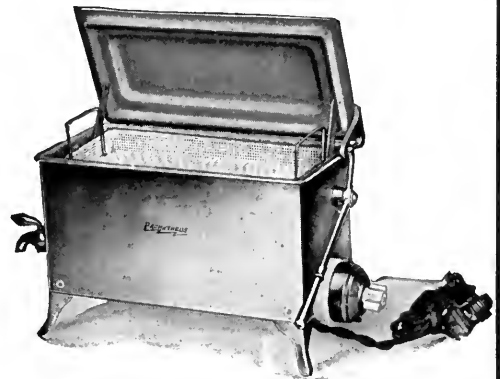
# PROMETHEUS

**NO SEAMS**

**NO SOLDER**

**NO TROUBLE**

The New Prometheus is a **one-piece sterilizer**. It is protected by the New Improved Safety Switch which operates without fuse pins and protects the sterilizer from overheating and damaging the instruments.



Made in three sizes

### DRY HEAT

Dry Heat may be obtained by simply emptying the sterilizer and turning the switch to Low. The sterilizer will automatically maintain a temperature at which dry sterilization will occur.

## PROMETHEUS ELECTRIC CORP.

352 W. 13th STREET

NEW YORK CITY

# Lukens Sterile Catgut

TRADE (Bartlett Process) MARK



**Make the Test Yourself**  
**Compare It Point for Point With any Other Catgut**  
**We Will Send the Samples**

Sizes 00-4 Plain

C. DE WITT LUKENS CO.  
4908 Laclede Ave.  
ST. LOUIS, MO., U.S.A.

Sizes 00-4 Tanned

An ornate, decorative frame containing text and illustrations of surgical sutures. The frame is adorned with roses and classical columns. In the center, the text reads "Valuable Assets of Surgery" and "D&G Sutures". Below this, a logo features the letters "D&G" inside a diamond shape. Two sutures are illustrated: one on the left labeled "KALMERID Plain Catgut" and one on the right labeled "KALMERID Plain Catgut".

Valuable  
Assets of Surgery

D&G Sutures

See Descriptive Price List in this Issue

**DAVIS & GECK, Inc.**  
*Surgical Sutures Exclusively*

211-221 Duffield Street - Brooklyn, N.Y., U.S.A.

COPYRIGHT JUNE 1923 D & G INC.

# ANNALS *of* SURGERY

VOL. LXXVII

JUNE, 1923

No. 6

## SURGICAL RELATIONS OF THE SYMPATHETIC NERVOUS SYSTEM\*

BY GEORGE P. MULLER, M.D.

OF PHILADELPHIA, PA.

MUCH might be written upon the relations of the sympathetic nervous system to abdominal diseases and their symptoms. The greater part of the sympathetic ganglia are massed in the abdomen, the most important actions of the vagus nerve, except its influence on the heart, are exerted there, and in the pelvis we have the sacral autonomic. Beginning a number of years ago with the appearance of the monograph of Eppinger and Hess and continuing to the present day, attempts have been made to rewrite physiology and pathology upon the basis of vagotonia and sympatheticonia. Something has been gained, but as Carlson<sup>1</sup> well says, "The uncritical use of these terms in the sense of established etiology of well-known disease complexes retards medical progress." Alvarez<sup>2</sup> believes that while the theories of vagotonia and sympatheticonia may eventually prove useful, he thinks that the foundations are so shaky that some day the whole edifice is going to go. As Alvarez puts it, we should learn from Gaskell and others the lesson that the sympathetics are not separate and distinct brain systems, but are there to conduct and not to exercise faculties requiring almost human intelligence. "There are times when the animal as a whole needs to communicate with its digestive tract; there are times also when one end of the tract must communicate with the other; and on all these occasions the extrinsic nerves come into play. The vagi carry feelings of hunger and of satiety from the stomach to the brain; they help in adjusting the tone of the stomach wall to the food coming down the oesophagus; and they carry the stimuli that give rise to the psychic secretion of gastric juice. If the food must be rejected by vomiting, they carry the impulses which bring the abdominal muscles to the aid of the stomach. Moreover, they probably carry messages from the digestive tract which make the animal feel comfortable and sleepy. The splanchnics serve largely to quiet the tract and to stop digestion when the body is distressed or injured. The extrinsic nerves probably have much to do with the digestive upsets with disease elsewhere in the body, but these changes can be accounted for also by actual damage to the gastrointestinal muscle."

\* Annual Oration before the Philadelphia Academy of Surgery, December 4, 1922.

Some years ago, enthusiastic over Eppinger and Hess, I tried to work out a complex which would distinguish a free and supposedly chronically diseased appendix from one adherent to the parietal peritoneum or cæcum, based on purely vago-phenomena of the former, but my analysis was not fruitful. I am not sure that the vagus control stops at the end of the ileum and furthermore an irritated ascending colon will produce spasm of the ileo-cæcal valve and imitate the vagotonic group of symptoms.

Abdominal pain and discomfort constitute the keynote of the group of symptoms characteristic of surgical abdominal disease, and it is a commonplace for us to say that in the area supplied by the sympathetic network there is no pain, that the liver, intestines, stomach or other viscera may be touched, cut, pinched or burned and yet not feel pain. Head,<sup>3</sup> in a most interesting paper published recently, calls our attention to the fact that so long as the internal organs are discharging their functions normally the afferent impulses which they may originate do not enter consciousness. Internal surfaces are unable to respond to such artificial stimuli to which they have never been exposed during the life of the individual or race. But the hollow viscera, such as the stomach and the bladder, react briskly to changes in tension, which are their natural mode of stimulation. Hyperacute or long-continued visceral irritations may overcome the resistance of the higher centres and sensation follows. Head applies this reasoning to appendicitis. "In the early stages before perforation has taken place, widespread pains may be present in the abdomen corresponding to the afferent supply of the upper parts of the digestive tract. Such pains are due to abnormal movements of the stomach and intestine and express the reaction of normal parts to a lesion situated in some allied physiological system." When perforation occurs these phenomena are replaced by the local manifestations.

Spasm is the most important physiological phenomenon resulting from intra-abdominal irritation and the familiar pylorospasm is the most conspicuous example. Surgical treatment aims to remove such irritation and relieve spasm, as after appendicectomy, gall-stone operations or gastro-enterostomy. A more direct method of attack has been proposed by Braun,<sup>4</sup> who advocates division of the gastro-hepatic and gastro-colic omenta in the region of the pylorus to alleviate painful stomach spasm. Enterospasm may occur and I have operated on at least two patients suffering from acute abdominal pain in which a contracted segment of the small intestine several feet in length was the only finding. In one case it relaxed and dilated while I was handling it. A third patient had contraction of nearly the whole length of small intestine following a gunshot wound with a perforation. The relation which such conditions bear to the vagus and sympathetic, the action of the pelvic sympathetic on the bladder and uterus and so on, are of interest and importance, but I must pass over this vast chapter. I have had two cases of automatic bladder after complete destruction of the spinal cord in the dorsal region. The patients are able periodically to empty the bladder,



although voluntary control is lost. That this does occur often is due to the coincident cystitis interfering with bladder action.

From the standpoint of operative surgery little is done directly to the abdominal sympathetics. A new method of local anæsthesia has been introduced by Kappis and others whereby the splanchnics are blocked by injecting the semilunar ganglia. Let us next consider the peripheral sympathetics.

*Resection of the Cervico-thoracic Nerve.*—This operation, advocated principally by Jonnesco, was at first performed for the treatment of epilepsy, but was then applied to the cure of exophthalmic goiter, migraine, trifacial neuralgia, glaucoma, and recently to angina pectoris. As done by Jonnesco the entire nerve is removed except in glaucoma, where only the superior ganglion is resected.

*Epilepsy.*—Cervical sympathectomy proved a failure as a treatment for epilepsy. The anatomical basis for the operation rested on the fact that the superior cervical ganglion is connected by post-ganglionic fibres with the blood-vessels of the brain, the constrictor fibres probably following the course of the internal carotid artery. A number of deaths attended the operation not only in epilepsy, but in goiter and other diseases, and a probable cause has been brought out recently by Orr and Sturak,<sup>5</sup> who found distinct lesions consisting of a paralysis of vessels in the cerebral cortex, Ammon's horn, amygdaloid nucleus and pyriform lobe after section of the cervical sympathetic. A new operation recently suggested by Fisher<sup>6</sup> probably is destined also to the limbo of useless procedures. He advanced the theory that a reduction of the adrenal substance in the body would reduce the tendency to convulsions. Accordingly, adrenalectomy has been performed about thirty times by four or five German surgeons, but the results were disappointing. More important than epilepsy is the relation of the sympathetics to goiter.

*Goiter.*—It has long been known that the sympathetic nerve supply of the thyroid gland follows the superior thyroid artery, and Drobniak<sup>7</sup> believes that nerves are given off from the second cervical ganglion uniting with the first cardiac nerves and then sending branches along the inferior thyroid arteries. Jaboulay, Jonnesco and others some years ago advocated the removal of the cervical sympathetics for exophthalmic goiter but the operation has never met with support. Ligation of the superior vessels is regarded by many surgeons as not only favoring anæmia, but also as a means of cutting off the sympathetic supply. Crile<sup>8</sup> states that "the greater part of the benefit from ligation is the result of a break in the nerve supply of the thyroid since the principal sympathetic nerves run in the walls of the superior thyroid arteries." Recently, Odermatt<sup>9</sup> reports the results of a study of the sensations experienced during ligation of the thyroid vessels. If the artery was dissected bare, ligation was painless. If periarterial tissue remained, the ligation pain was constant in the anterior branch of the superior thyroid artery but inconstant in the posterior branch of the superior thyroid and in the inferior thyroid. Leriche<sup>10</sup> practised superior thyroid sympathectomy on one side in a case of goiter and noted a remarkable regression in its size. He also<sup>11</sup>

speaks of supplementing this operation in toxic cases with tachycardia by resection of the superior cardiac nerves, and of the control of the exophthalmos by pericarotid sympathectomy. Some years ago I performed bilateral removal of the superior cervical ganglion for persisting exophthalmos, but while some improvement was noted the patient did not consider the result as satisfactory.

*Glaucoma.*—I also, in one case, removed the upper ganglion for acute glaucoma, but the operation failed to save the eye. A number of years ago this was thought justifiable and Wilder<sup>12</sup> collected sixty-eight cases with good results in the majority, especially in the chronic form. The operation seems to be rarely done at present and De Schweinitz<sup>13</sup> does not advocate it.

*Optic Atrophy.*—Sympathectomy has been performed for this condition by Abadie,<sup>14</sup> who resected one centimetre of the carotid sheath to interrupt the sympathetic innervation. The atrophy in his case was characterized by a restriction of the visual field on the nasal side. The immediate results were brilliant, the visual field becoming normal in approximately two weeks, but two months after the operation the condition retrogressed until about the same as before operation. Ligation of the carotid was followed by similar transient improvement.

*Parotid Fistula.*—In 1914, Leriche<sup>15</sup> proposed resection of the auriculo-temporal nerve to suppress parotid secretion, based on Bernard's observation that this nerve is the secretory nerve for the parotid gland. The operation has been endorsed by Dieulafe,<sup>16</sup> Weitz,<sup>17</sup> Tromp<sup>18</sup> and others, but Cole<sup>19</sup> condemns the operation by comparing it to the plumber who would repair a leaky pipe by cutting off the water supply of the house.

*Angina Pectoris.*—Without attempting any argument of the somewhat obscure etiology of this disease, I can recount the attempts at its cure, or rather amelioration, by surgical measures. In 1916, Jonnesco<sup>20</sup> removed the middle cervical ganglion, the sympathetic trunk, the plexuses about the inferior thyroid and vertebral arteries, the inferior cervical and first thoracic ganglia of the left side in a case of typical angina pectoris. Four years later he examined the patient and reported the case. During the subsequent four years the patient had no attack of angina and follows his occupation as a clerk. The cardiac action, pulse and respiration were found normal. X-ray examination showed a slight dilatation of the aorta with thickening and a broadening of the heart shadow. This report was followed by the report of another case. The second patient operated on by Jonnesco<sup>21</sup> was fifty-four years old and for eight years had suffered from attacks of suffocation and from paroxysms of pain radiating to the cervical region and left arm. The left cervico-thoracic nerve was resected and marked improvement was noted during the ensuing four months. Jonnesco apparently believes that the phenomena of angina pectoris are due to irritation of the terminal filaments of the nerves of the sympathetic plexus in the walls of a chronically inflamed aorta. He only resected the left side because the patient refused to go further, and was surprised at the completeness and permanence of the relief.

Jonnesco's operation has brought to light another case, namely that of Renon, who had a woman patient with aneurism of the aorta which was discreet and fusiform. The case was referred to Tuffier,<sup>22</sup> who exposed the aorta by a transverse division of the sternum and wrapped the length of the aneurism with a strip of fascia lata. Renon concluded that there was some amelioration of symptoms and the general state better, but I would judge that the operation actually accomplished little. However, in the discussion of this case Delorme pointed out that the act of freeing the aneurism caused the division or removal of the sympathetic plexuses, which really supplied the reason for the relief of pain. In a later paper Delorme<sup>23</sup> suggests that sympathectomy would be worth while as an effort to relieve the pains of aortitis.

*Periarterial Sympathectomy.*—In 1913, Leriche published his first communication and since then about twenty others have appeared from this surgeon alone. The technic of the operation is well known and consists in the removal of 8 or 10 cm. of the adventitia of the artery. While the stripping is in progress a marked contraction of the artery is noted, followed by a peripheral dilation which becomes attenuated in five or six days and disappears after three or four weeks. This vasodilation, according to Leriche, is the therapeutic effect of the operation, but Bruening and Stahl<sup>24</sup> believe that the hyperæmia is not the only factor at work in producing beneficial results from sympathectomy. There is a transposition of the entire vascular function as a result of the interruption of the normal sympathetic stimulation. The autonomous nature of the vascular nerve apparatus explains the return to normal after a brief period of vasodilation. Handley<sup>25</sup> very recently has published a substitute method for sympathectomy as performed by Leriche. After exposing the artery he injects four minims of alcohol at each of four equidistant points around the circumference of the vessel, the needle being introduced obliquely into the tunica adventitia. Two cases were injected, both of actual gangrene. In the first there was recession of the line of gangrene and the formation of new lines of demarcation around the toes. In the second, an unfavorable case, the operation brought but slight benefit but definitely accentuated the vasodilation already present. Handley believes his method superior to the original one because it is simpler to perform, does not produce the initial stage of vasoconstriction and attains immediately the vasodilator results aimed at by the operation. As usual we have a German claim for priority in the discovery of this operation in the person of Heinrich Highier.<sup>6</sup>

In his article in the *ANNALS OF SURGERY* last year, Leriche<sup>27</sup> reports that he has performed sympathectomy sixty-four times for various affections, sometimes with remarkable success and sometimes with complete failure. Many other cases are recorded in the literature and I myself have had the opportunity to do this operation thirteen times on eleven patients. The anatomical aspects of the operation are rather interesting. The arterial sympathetics are probably remains of the primitive nerve nets of the low

scale animal and perhaps act as "booster" stations for the vasomotor impulses coming in from the somatic nerves. How much autonomy they may have is not clear. They are situated in the adventitious tunic of the artery. The vasomotor innervation of the arteries of the extremities is made possible by the re-entry into the spinal roots of sympathetic fibres by way of the gray rami communicantes; they intermingle with other afferent and efferent fibres and pursue a straight course to the periphery. Along the course of the peripheral nerves twigs are given off from time to time which connect with or form the sympathetic net on the blood-vessels. But little information is given in the text-books regarding these twigs and our knowledge is rather scanty.

*The Nerves to the Arteries.*—In 1914, some observations from the Western Reserve University were published which sum up and add to the existing knowledge. Kramer and Todd<sup>28</sup> investigated the nerve supply to the arteries of the arm and found that the subclavian and proximal part of the axillary arteries received a nerve supply directly from the sympathetic chain, between or including the middle and inferior cervical ganglia which reached the artery in the interval between the scalenus anticus and the bone. The portion of the subclavian artery immediately adjacent to its origin was supplied by a varying number of twigs from the musculo-cutaneous nerve, the radial from the superficial ramus of the radial nerve and the ulnar from the ulnar nerve in the forearm. Todd and Kramer point out that, "the more distal arteries are supplied by sympathetic fibres which have travelled to their distribution along special nerve-trunks and not along main vessels. These twigs are distributed to the vessels from the nerve-trunks at intervals; the intervals growing shorter as the more distal portions of the limb are reached, as though a greater wealth of nerves was needed in these parts. Possibly the diminishing size of the member and consequently the greater need for constant regulation in size of vessels may be associated with this fact. Again the distribution of nerves to vessels corresponds pretty closely with the distribution of nerves to the skin and musculature of the same area." The clinical significance of the nerve supply to the blood-vessels of the upper extremity is well illustrated in cervical rib. The symptoms of the lesion may be motor, sensory, vascular, or sympathetic. In the latter case it is not necessary that the sympathetic net on the subclavian artery must be involved because pressure on the brachial plexus may involve the sympathetic fibres reaching into the median ulnar or radial and thence to the arterial sympathetic. Todd<sup>29</sup> reported a case in 1912 with no palpable pulse, operation revealing no compression of the vessel, and in which he believes the vascular phenomena were sympathetic in origin. I think I have seen an exactly comparable case in which vascular symptoms began at the periphery and there was no palpable pulse. Sympathectomy was followed by relief of pain and the hand became warm. Later, cervical rib resection was followed by cure.

Another interesting point has been brought out by study of the arm sympathetics. Tournay<sup>30</sup> has shown that section of the sympathetic produces

a reinforcement of sensation. Regard<sup>31</sup> reports a case where after suture of an ulnar nerve, sensation was restored almost immediately and vasomotor disturbances disappeared. Motion was not affected even after eight months. He explains the phenomenon by the fact that the dissection removed fibres of the sympathetic about the ulnar which permitted sensation to be transferred by the median nerve.

The distribution of nerves to the arteries of the lower extremity has been investigated by Potts.<sup>32</sup> He found that the femoral artery received branches, after its bifurcation into the superficial and deep femorals, from some independent twigs and from muscular branches of the femoral nerve; the lower part may receive a twig from the saphenous nerve. The popliteal artery is supplied by the tibial and in many cases also by the azygos nerve. The posterior tibial is richly supplied from the tibial nerve and from the nerve to the flexor hallucis longus muscle, the perineal artery is reached by the muscular branches to the popliteus and flexor longus hallucis. The anterior tibial and the dorsalis pedis receive twigs from the peroneus profundus.

Leriche divides the phenomena resulting from injury of the periarterial sympathetic plexus into two groups: In the first group the characteristic physiologic reaction is pure, with two striking aspects, painful ischæmia and consecutive vasodilation; in the second, reaction is disturbed and gives various troubles.

In the first, Leriche classes "stuteur arterielle" and Raynaud's disease. Sudden arterial spasm may occur and be so intense as to lead to gangrene. It may occur after trauma, such as fracture or in war wounds where concussion of the artery has occurred. Reichle<sup>33</sup> has noted two cases of segmental spasmodic contraction of a large vessel after trauma. If not recognized unnecessary amputations may be done. Another phase of this gangrene has been described by Oppel,<sup>34</sup> writing on spontaneous gangrene, who believes that the adrenal plays a part in its production through overaction, the increased amount of adrenin causing an ischæmia and a disturbance in the nutrition of the arterial walls. We might theorize that if this is so and if the effect of the emotions, particularly fear, is to increase the flow of adrenin, then we have a reasonable explanation of the etiology of Buerger's disease in the Russian Jew.

*Raynaud's Disease.*—First described by Raynaud in 1862, this affection is distinctly a disturbance of the vasomotor mechanism. The local syncope and the asphyxial attacks are constrictor in nature. Rarely the dilator phenomena of hyperæmia are observed. Halpert<sup>35</sup> has described in detail the capillary changes in a patient with typical Raynaud's syndrome. She found increased tortuosity of the capillaries, as well as groups of capillaries from three to five times larger than normal. The blood flow was slow. During an attack the giant capillaries became fuller, especially in their venous portion, and exhibited changes in contour, such as projections and strictures. The blood appeared to be pushed through the vessel by a peristaltic-like wave. In a severe attack the blood became completely stagnant and blue. These

observations correspond strikingly to the explanation originally offered by Raynaud. Gangrene is a terminal phenomenon and is usually characteristic. The essential features of this disease are well known and need not be repeated here. Recently Buchanan<sup>36</sup> has presented a study of the cases seen in the Mayo Clinic, sixty-seven in number.

Judging generally by the reported cases the results of treatment in this disease have not been very successful. If we agree that vasoconstriction is the predominant influence then sympathectomy causing dilation is worth while. Leriche has twice done this operation in Raynaud's disease with good results. I have performed sympathectomy on both brachials in a case of Raynaud's disease occurring in a man seventy years old. He had the characteristic "dead fingers" with other symptoms and early gangrenous patches on the skin of the hands. He was practically cured. Perhaps we are justified in adding to this group a condition known as acrocyanosis.

*Acrocyanosis.*—Many of us have no doubt noted the occurrence of cold and cyanotic hands in certain persons, particularly those of an asthenic type, and Cordier<sup>37</sup> believes that a localized arterial hypertension, especially of the hands and feet, will occur more frequently in the future as the result of "the intoxications, commotions, fatigues and latent infections" of the War. Sufferers from the so-called "irritable heart" of soldiers often exhibit acrocyanosis to a marked degree. Boas<sup>38</sup> studied twelve cases of acrocyanosis and found that "when the hands are cold and cyanotic, the capillary blood-pressure is low and the flow sluggish. This cannot be due to a constriction of the venules, but must depend on a constriction of the arterioles or a marked dilatation of the capillaries. It is significant, too, that the capillaries become fuller when the hands are warm. If the venules were constricted, the capillaries would be engorged during the period of cyanosis."

Warmth will usually accelerate the blood flow in the capillaries, but in intractable cases I would suggest the performance of sympathectomy as an experiment to note the permanency of the resulting vasodilation.

In the second group described by Leriche are placed a miscellaneous number of affections characterized by a disturbance of physiological reaction from contracture of too long duration or abnormally persisting dilatation. The only pathology noted is an adhesion of the vessels to the common sheath, or an increase of the vascularization of the adventitia. Sometimes nothing is seen. Leriche no doubt is over-enthusiastic when he ascribes disturbance of the sympathetic innervation as the cause of trophic ulcers following nerve section, but there is some ground for the opinion that it plays a part. Stopford<sup>39</sup> believes "there is strong reason to conclude that irritative nerve lesions can produce changes in the walls of the arteries supplied by the affected nerves. These changes seriously reduce the calibre of the vessel and must inevitably diminish the blood supply to the muscles, bones, joints and skin." It has been pointed out also that injury in regions remote from the large blood-vessels may be accompanied by pain or trophic disturbances, but Leriche counters by stating that with injury in a richly furnished zone

of sensory innervation the vasomotor disturbances may be due to ortho- or antidromic reflexes, starting from the injured point, and referred back along the periarterial sympathetics. Much was written during the War about the effects of nerve ischæmia in wounds of arteries, and trophic, sensory, and motor abnormalities were noted. The reaction was thought to be similar to that occurring in the optic nerve after thrombosis or embolism of the central retinal artery. Ischæmic myositis after blood-vessel injuries has been discussed also by Stewart <sup>40</sup> and ischæmic paralysis well presented by Burrows. <sup>41</sup>

Physiologic research is needed to further elucidate the importance of the sympathetics in these conditions, but all in all there is much to support the claim of Leriche.

Clinically, successes have been claimed in (1) causalgia after war wounds; (2) certain painful crises preceding gangrene caused by obliterative endarteritis; (3) vasomotor trophic neuroses with contractures; (4) painful stump; (5) trophic ulcerations of stumps and extremities; (6) trophic oedema; (7) ischæmic paralysis of the forearm, etc.

In my own experience the most gratifying results, aside from the cases of Raynaud's and cervical rib already mentioned, have been in (1) a painful stump from amputation eight years previously and with almost continuous pain during that time. He had been operated on without relief six months previously. Following sympathectomy, complete relief was experienced. (2) A case of threatened or beginning gangrene of the toes with calcareous tibial arteries as shown by X-ray and marked pain, was not only cured of pain but the gangrenous areas cleared up in a most remarkable manner. I saw this man seven months later and his foot is perfectly well, except for cyanosis in the dependent position. (3) A case of tropho-neuroses with contractures and pain in the foot. Marked relief of both attended sympathectomy. One of both attended sympathectomy. One case of painful stump was a failure, two cases of Buerger's disease were slightly improved, a case of gangrene of the fingers with bilateral sympathectomy was distinctly improved. I had one fatality in an elderly woman with acrocyanosis and arteriosclerosis, following infection of the wound, hemorrhage and death after ligation of the femoral artery. Matona <sup>42</sup> reports a similar occurrence. Recently I assisted Doctor Frazier perform sympathectomy in a case of tropho-neuroses of unknown origin with burning pain and oedema of the foot, the patient being completely relieved by the operation.

It will be noted that six of the patients were cured and in one case gangrene was probably stayed; the other four must be classed as failures.

*Causalgia.*—This is a painful vasomotor neurosis resulting from irritation of a mixed nerve. It was first described by Weir Mitchell and he coined the name. From the standpoint of this paper the following from Mitchell <sup>43</sup> is of interest: "Further study led us to suspect that the irritation of a nerve at the point of the wound might give rise to changes in the circulation and nutrition of the parts in its distribution, and that these alterations might be of themselves of a pain-producing nature." Many articles on causalgia have

appeared since the War, mostly from French sources, the best article in English being, I believe, that by Carter.<sup>44</sup>

While the pain is essentially a peripheral reflection along somatic nerves, usually the sciatic or median, set up by peripheral irritation, yet the sympathetic plays a part in several ways. After division of one of these nerves pain may continue, the impulse travelling along anastomosing sympathetic fibres in a centripetal direction and thence reflecting along centrifugal fibres. Leriche believes that causalgia is due to a neuritis of the periarterial sympathetic system and not to the direct injury to the nerve trunk. But there is much evidence on record to show that causalgia may occur when no injury to the main vessel could have occurred. Potts, from his anatomical study referred to above, states that "local damage to a large artery will injure the vascular plexus at the point of damage only, but will not account for changes produced in the vessel at a distance from the injured site. If absolute proof can be obtained of the relation between damage to the sympathetic supply of an artery and morphological changes in the vessel itself of more than focal character, then the nerve damage must occur at some distance from the arterial tree, and not simply to the sympathetic plexus as it lies on the vessel."

Nevertheless theory sometimes must give way to facts. Leriche states that in causalgia after war wounds sympathectomy gave him in nine cases two complete failures, two satisfying improvements, and five excellent results. Platon<sup>45</sup> reports excellent results in eighteen cases, in sixteen the pain stopping at once and in two more gradually. The motor nerves were involved in all but two of the cases. Girou<sup>46</sup> differentiates causalgia from sympathetic irritation pain, and diagnoses the latter by the occurrence of flexion contraction of the hand, indicating a vessel lesion involving the sympathetics. You will remember that Lewis<sup>47</sup> following the suggestion of Sicard<sup>48</sup> reported three cases of causalgia treated by intraneural injection of 60 per cent. alcohol in which the patients experienced almost instant relief. He prefers this method to sympathectomy because of its simplicity.

#### REFERENCES

- <sup>1</sup> Carlson: *Journal A. M. A.*, 1922, vol. lxxix, p. 1101.
- <sup>2</sup> Alvarez: *Mechanics of the Digestive Tract*. Hoeber, 1922.
- <sup>3</sup> Head: *British Medical Journal*, 1922, vol. i, p. 1.
- <sup>4</sup> Braun: *Zentralbl. f. Chir.*, 1921, vol. xlviii, p. 267.
- <sup>5</sup> Orr and Sturrak: *Lancet*, 1922, vol. i, p. 267.
- <sup>6</sup> Fisher: *Ztsch. f. d. ger. Neurologie u. Psychiatrie*, 1920, p. 56.
- <sup>7</sup> Drobnik: Quoted by Hertzler, *Diseases of Thyroid Gland*, Mosby, 1922.
- <sup>8</sup> Crile: *The Thyroid Gland*, Saunders, 1922.
- <sup>9</sup> Odermatt: *Beitr. z. klin. Chir.*, 1922, vol. i, p. 127.
- <sup>10</sup> Leriche: *Lyon Chir.*, 1920, vol. xvii, p. 109.
- <sup>11</sup> Leriche: *Presse Méd.*, 1920, vol. xxviii, p. 301.
- <sup>12</sup> Wilder: *Journal A. M. A.*, 1904, vol. xlii, p. 350.
- <sup>13</sup> De Schweinitz: Personal communication.
- <sup>14</sup> Abadie: *Presse Méd.*, 1920, vol. xxviii, p. 606.



# RELATIONS OF SYMPATHETIC NERVOUS SYSTEM

- <sup>15</sup> Leriche: Lyon Chir., 1914, vol. xi, p. 256.
- <sup>16</sup> Dieulafe: Presse Méd., 1917, vol. xxxiii, p. 392.
- <sup>17</sup> Weitz: Deutsche Zeitschr. f. Chir., 1919, vol. cxlix, p. 419.
- <sup>18</sup> Tromp: Zentralbl. f. Chir. 1917.
- <sup>19</sup> Cole: Lancet, 1919, vol. i, p. 971.
- <sup>20</sup> Jonnesco: Bull. de l'Acad. de Méd., 1920, vol. lxxxiv, p. 93.
- <sup>21</sup> Jonnesco: Bull. de l'Acad. de Méd., 1921, vol. lxxxvi, p. 208.
- <sup>22</sup> Tuffier: Bull. et Me. della Soc., 1920, p. 166.
- <sup>23</sup> Delorme: Bull. de l'Acad. de Méd., 1921, vol. lxxxv, p. 582.
- <sup>24</sup> Bruening and Stahl: Berlin. klin. Wchnschr., 1922, vol. i, p. 1402.
- <sup>25</sup> Handley: 1922, vol. ii, p. 173.
- <sup>26</sup> Heinrich Highier: Berlin. klin. Wchnschr., 1922, vol. i, p. 1208.
- <sup>27</sup> Leriche: ANNALS OF SURGERY, 1921, vol. lxxiv, p. 385.
- <sup>28</sup> Kramer and Todd: Anat. Rec., 1914, vol. viii, p. 243.
- <sup>29</sup> Todd: Lancet, 1922, vol. ii, p. 362.
- <sup>30</sup> Tournay: Comptes Rendus de l'Acad. des Sciences, 1921, vol. clxxiii, p. 939.
- <sup>31</sup> Regard: Bull. et mem. Soc. de Chir. de Paris, 1922, vol. xlviii, p. 619.
- <sup>32</sup> Potts: Anat. Ariz., 1914, vol. xlvii, p. 138.
- <sup>33</sup> Reichle: Beit. z. klin. Chir., 1921, vol. cxxiv, p. 650.
- <sup>34</sup> Oppel: Lancet, 1922, vol. ii, p. 116.
- <sup>35</sup> Halpert: Quoted by Boas.
- <sup>36</sup> Buchanan: Amer. J. Med. Sc., 1922, vol. clxiv, p. 14.
- <sup>37</sup> Cordier: Archiv. des Mal du Coeur. 1920, vol. xiii, p. 241.
- <sup>38</sup> Boas: Jour. A. M. A., 1922, vol. lxxix, p. 1404.
- <sup>39</sup> Stopford: Lancet, 1918, vol. i, p. 465.
- <sup>40</sup> Stewart: Brit. Med. J., 1918, vol. i, p. 199.
- <sup>41</sup> Burrows: Brit. Med. J., 1918, vol. i, p. 199.
- <sup>42</sup> Matons: Semana Med., 1922, vol. ii, p. 98.
- <sup>43</sup> Mitchell.
- <sup>44</sup> Carter: Journal Neurology and Psych., 1922, vol. iii, p. 1.
- <sup>45</sup> Platon: Archiv. Franco-Belg. de Chir., 1921, vol. xxv, p. 226.
- <sup>46</sup> Girou: Presse Méd., 1918, vol. xxvi, p. 584.
- <sup>47</sup> Lewis: Journal A. M. A., 1920, vol. lxxiv, p. 1.
- <sup>48</sup> Sicard: Lancet, 1918, vol. i, p. 213.

## THE SURGICAL TREATMENT OF UNILATERAL PULMONARY TUBERCULOSIS\*

BY EDWARD ARCHIBALD, M.D.

OF MONTREAL, CANADA

ONE significant example, among many, of the extraordinary progress of medical science during the last half century, is found in the history of the therapeutics of pulmonary tuberculosis. Hippocrates thought of consumption as practically hopeless, and our grandfathers regarded it in no other way. The lapse of two thousand years showed but little advance in the cure of this disease. Then, of a sudden, within the space of fifty years, appear three great landmarks of progress. Brehmer and his student, Detweiler, in the middle third of the last century, revolutionized the treatment of pulmonary tuberculosis with that method which we now call "hygienic,"—fresh air, forced feeding, and rest; and Trudeau, of Saranac Lake, brought all this to the notice of the profession in this country over thirty years ago. The second landmark was the discovery of artificial pneumothorax by Forlanini, in the eighties; and no one now disputes the extraordinary effect for good which that procedure exercises in selected cases. And now we come to the third landmark, that is, the operative treatment of such patients as remain insufficiently benefited by hygienic treatment, and in whom artificial pneumothorax is found impossible. We are not in this country accustomed to consider ourselves behind the times in matters of surgical progress; yet in this subject we are backward. It must be admitted that the rôle of surgery in this disease has been worked out almost exclusively in Germany and Switzerland. Friedrich, of Marburg, and Henschen, Sauerbruch's assistant, both read articles on this subject before this society before the war. Later came Scandinavia, England, and France, while we on this side of the water come last. It should be recalled, however, that in 1909 Freeman, of Denver, advised the resection of a few ribs anteriorly over the diseased apex, and proposed a truss for local pressure upon the indrawn area. I have found very few other references in American literature to this subject. Meyer, Shortle, and one or two others have reported isolated cases.

As a result of somewhat particular circumstances, my own interest in the problem was early aroused, and my first case dates back to 1912. The second patient came in 1914. Then the war intervened; but since 1917 I have had twenty-five other cases. It is on the basis of this material that I venture to make this communication.

The operation at present understood under the term of extrapleural thoracoplasty has been now pretty well standardized by Sauerbruch, and consists, briefly, in the resection of the first or second to the tenth or eleventh

---

\* Paper read before the American Surgical Association, May 3, 1923.

ribs, posteriorly. Various lengths of the ribs are taken out. The periosteum is usually left. The operation is always posterior, and must practically always begin over the lower lobe and be finished over the upper. It is done preferably in one stage, but very frequently in two.

The object of the operation is two-fold, on the one hand to compress the lung by the inward spring of the sectioned ribs, and on the other hand to set the lung at physiological rest. The spring of the ribs is very considerable. Often after resecting from three to four inches of any one of the middle ribs I have seen the two ends come almost together. Physiological rest of the lung is the rest from respiratory activity. The lung expands very little when it is deprived of its rib support. Rib resection acts as an actual cutting of the bond which unites respiration with thoracic movements. Consequently, if these two objects are fulfilled, the great principle of rest, which is the keynote of tuberculosis therapy, comes into full utilization.

The posterior operation nearly always brings about a large measure of improvement in the first few weeks or months. Sputum and cough are both greatly lessened, or even disappear. Fever, if previously present, is abolished; and there is a marked increase in appetite, in weight, and in the sense of general well-being. In some cases, however, this early improvement is followed by a relapse, or it remains considerably short of an ideal result. Under these circumstances, X-ray photographs will usually show the persistence of uncompressed or insufficiently compressed cavities high up in the upper lobe. The spring of the ribs in the uppermost portion of the thoracic barrel is notably less than in the middle and lower areas, and the degree of lung compression afforded by resection is correspondingly less. For such cases, the apicolysis of Tuffier (who, however, designed the operation for early lesions localized to the apex in order to spare the healthy lower lobe) will be found to be decidedly worth while though at the cost of increased risk. This operation consists in a resection of the second rib in front and a peeling off of the apex from its *loge* in the attic of the thorax, always keeping outside the parietal pleura. This is combined with the implantation of a free fat transplant, or of paraffin (Baer), or of pedicled muscle flaps (Archibald), in order to fill up the space created and maintain lung compression.

The essential indications for the operation may be set down briefly. They are, first, that artificial pneumothorax shall have been tried and found impossible, or insufficient; secondly, that there shall be no disease, or only slight disease, and that arrested, in the other lung; thirdly, that there shall be no serious disease elsewhere in the body. There is no need in this place to go deeply into particulars concerning the selection of cases. In this matter, the assistance of the expert in tuberculosis is absolutely necessary, and indeed the bulk of the patients will come from those who practise this specialty. Team work between the surgeon and the internist is perhaps of more value in this than in any other department of borderline surgery. One may say, however, that the best cases for the operation are the "chronics" in whom

destruction and fibrosis have gone hand in hand, so that Nature, though she may have already done much in the way of cure, has nevertheless come to her limit in the degree of contraction which fibrosis is able to bring about; in other words, those in whom the diaphragm is pulled up, the chest fallen in, the trachea and the heart pulled across. In such patients, as a rule, the lung contains cavities which are situated usually in the upper lobe, and are held open by the rigidity of the ribs and the fibrous adhesions of the lung and pleura to the chest wall. Such cavities, so long as they remain open, can not possibly heal; and those who carry them are, in the true sense of the word, chronics. They may go along for years more or less comfortably, leading for the most part a sanitarium existence, expectorating considerable quantities of sputum, coughing a good deal, subject to bouts of fever from time to time; but ultimately they lose resistance and go down. Their outlook is not good. Though they live one year or many years, they still expect to die soon or late, and they live in that fear.

Now, in some of these, artificial pneumothorax is able to bring about an extraordinary change for the better; but in many this procedure is found to be impossible on account of adhesions, and the only thing that remains is an extrapleural thoracoplasty. It may be said at once that the results of extrapleural thoracoplasty are very little, if at all, behind those of artificial pneumothorax. Sometimes they are even extraordinary. My own opinion is that once artificial pneumothorax has been considered, tried, and found impossible of execution, then, at that very moment, the question of surgical intervention should be considered. It is not right to throw up the sponge because air can not be got into the chest. On the contrary it is absolutely justifiable to operate, and that without delay, save for particular circumstances which may render operation inadvisable.

Considering the frail nature of the material with which we are working, it may well be asked, whether the immediate danger of operation is not so great as to be practically prohibitive? The answer is most decidedly in the negative. With proper care to avoid shock, with the use of gas-oxygen and local anæsthesia, with a right selection of cases, with attention to post-operative treatment, there will be, with the posterior operation, practically no operative mortality. Yet there are dangers! They are primary and late. The first, briefly stated, is this: too extensive a removal of ribs, as in Friedrich's method of total resection, leaves the heart unsupported, causes mediastinal flutter, paradoxical respiration with "pendulum" air, and is apt to kill the patient within the first week through failure of the heart and pulmonary œdema. My first patient, in whom, following Friedrich, I removed the whole thoracic cage on one side, was lost in this way. The second danger lies in the possible aggravation, after weeks or months, of the tuberculous disease in the "sound" lung (nearly always present, though slight and presumably arrested) as the result of the extra functional strain so suddenly thrown upon it. And if there be present in addition any mixed infection in the way of a chronic

mild bronchitis in the sound lung, this late danger may become an immediate danger, for the mild latent bronchitis may rapidly turn into an acute infective and purulent bronchitis, and this in turn into a spreading broncho-pneumonia, against which such invalid patients as these can offer no effective resistance. In this way, I lost one more patient, whose history I shall shortly relate in greater detail.

*Results.*—The total number of patients † upon whom I have operated for unilateral pulmonary tuberculosis is fifteen, not including two in whom I did the minor operations of phrenicotomy and the cutting of intrapleural adhesions. In these fifteen a posterior thoracoplasty has been carried out, with the exception of one in whom I resected the whole side of the bony thorax according to Friedrich's plan. The ages of these patients varied from twenty-seven to fifty-five years. The duration of the illness previous to operation was from two to twenty-two years. In six the chief disease was on the right side; in nine on the left; the better lung, ordinarily called the sound lung, was slightly affected in all, and in two it was considerably affected. One patient had laryngeal and one chronic intestinal tuberculosis. The patients came to operation in what one would call poor condition in eight cases; in fair condition in four cases; and in good condition in three. The Sauerbruch operation from the second or first to the tenth rib behind was done in eleven; a total resection in one; a partial resection in three. In these last either the upper or the lower lobe was already compressed by an artificial pneumothorax, which was maintained. Following the posterior operation I have in five of the cases, gone on to the operation of apicolysis, with freeing the lung apex, and in fact, of much of the upper lobe, and the implantation of muscle flaps, according to the method which I reported some two years ago.

The results, briefly stated, are these: Three died from the operation. Of these, one followed the Friedrich operation already mentioned. This patient died from œdema of the lungs and failing heart on the sixth day. Such a fatality need never occur again. It was due to an operation now deservedly abandoned. Another died on the twentieth day from streptococcus infection, arising in a small abscess hidden under the scapula. This patient had had sixteen punctures done in the attempt to induce artificial pneumothorax. He was a chronic case, twenty years sick, hectic, with multiple cavities. The needling had perhaps drawn infection from the lung into the back muscles, and the operation may have lighted this up. The third died after a third operation; that is, an apicolysis, following the two previous ones, posteriorly, on the sixth day, from œdema of the good lung, together with acute purulent bronchitis. On the other hand, practical cures in these fifteen cases number three. By that I mean, following Sauerbruch, almost complete disappearance of sputum, disappearance of bacilli and of cough, ability to do a certain amount of work,

† These have been referred to me by Doctor Parfitt of Gravenhurst, Doctor Byers of St. Agathe, P. Q., Dr. Lawrenson Brown, the late Doctor Paterson, and Doctor Packard of Saranac Lake, Doctor Miller of Kentville, N. S., Doctor Lloyd of Rochester, N. Y., Doctor Pottenger of Monrovia, Cal., and Doctor Pratt of Boston.

and general well-being. There were markedly improved three, slightly improved two, and stationary, three. Finally, one died twenty months after operation of the progress of the disease. In two of those of the last class, called stationary, the disease progressed to some extent in the better lung but their general condition remained good. The patient who died after twenty months was from the first not very suitable for the operation, inasmuch as his disease was a diffuse, almost pneumonic infiltration of the whole lung, with very little cavitation. Such patients, showing but slight tendency to fibrosis, are in a general way not good subjects. One needs the evidence of resistance; that is of fibrosis. He was considerably improved, nevertheless, for a period of some six to eight months, by the operation.

Excluding the first case of total rib resection, an operation which should not be considered at all in any modern statistics, the percentages work out as follows:

Operative mortality .....	14	per cent.
Late mortality, from progress of disease .....	8.5	per cent.
Practical cures .....	25	per cent.
Greatly improved .....	17	per cent.
Slightly improved .....	25	per cent.
Not improved .....	25	per cent.

The series is confessedly too small to justify laying much stress upon figures; but it should be remembered that, for humanitarian reasons, several cases have been accepted who were decidedly poor risks; that all those who died from the operation belonged to this class; and finally that six were operated on less than a year ago, of whom two are already so much better as to bid fair to become "practical cures." If one takes only those who were operated on over a year ago, the percentage of practical cures rises to  $33\frac{1}{3}$ .

I may add here a short note upon the results obtained by Sauerbruch, who, in a recently published book, gives the statistics of three hundred and eighty cases, and in a more recent article adds a further series of fifty-seven. In this last series there was no death following operation before the eighth day, at which time one patient died of pneumonia. The mortality in the first four weeks was 7 per cent., while in his larger series it was 12 per cent.; 26 per cent. had lost all sputum and bacilli; 42 per cent. might be considered as improved, although still under sanatorium treatment. The remaining 25 per cent. were either unchanged or had grown worse. These figures correspond accurately enough with those of the larger series of 381 cases in which Sauerbruch got 35 per cent. of cures and 40 per cent. of definite improvement.

When it is considered, as Sauerbruch remarks, that with rare exceptions only such patients have come under surgical treatment as had for years pursued the cure in various sanatoria—patients who were seriously ill, who had cavities and also sputum containing large numbers of bacilli, one must admit that the results of operation are decidedly encouraging. Naturally, the operation in and of itself does not cure the patient; but it affords nature the opportunity,

or the possibility, of developing further her own processes of cure, processes which had been arrested by the presence of anatomical conditions. Consequently it is obvious that sanatorium care is still necessary after operations; but whereas before operation this had come to the limit of its effectiveness, it gains through operation an increased capacity of doing good.

Lacking both time and space, I shall relate the histories of no more than two of these patients, one for warning, the other for encouragement.

*Case Reports.*—CASE I.—Mrs. McN., aged thirty-eight. Admitted to the Royal Victoria Hospital on September 29, 1920. This patient was referred to me by Doctor Pottenger of Monrovia, California.

The patient had been suffering from recognized pulmonary tuberculosis for eleven years, most of which time had been spent in sanatoria in the south west. The process had affected the whole left lung. There was extensive cavitation in both lobes, and quite enormous fibrotic contraction. There was also slight disease in the right apex and some infiltration with a possible small cavity in the right lower lobe. In July, 1920, she had what was probably an acute pleurisy of the right side, with fever up to 103, an increase of sputum from 60 to 130 c.c. and aggravation of the cough. During this illness, which lasted two weeks, she lost thirteen pounds, but recovered during the summer. There were no physical signs of the pleurisy which she apparently had had three months previously.

It was a difficult matter to decide whether one should take the risk of operating on this patient or not. The type of lesion in the left lung was certainly suitable for operation, although destruction was very great, but the presence of some disease on the right side, and the history of a probable pleurisy on that side three months before, suggesting as it did recent activity, indicated the necessity of caution. However, as she was running a practically normal temperature and a pulse of 70 to 90, and as there were no clinical signs of activity in the right side, I finally decided that the posterior operation at least might be undertaken. Accordingly on October 6th, under gas-oxygen and novocaine anæsthesia, I resected the 10th to the 6th ribs inclusive in lengths of from four to three and a half inches. The heart was felt beating very superficially under the 7th and 8th ribs, having obviously been pulled backwards by the fibrosis of the lung and adhesions to the posterior pericardium. The lung was felt diffusely infiltrated and hard in the upper third of the incision, but was softer in the lower part of the lobe. The wound healed *per primam*. On October 26th the second stage was done under the same anæsthesia, and the 2nd, 3rd, 4th, and 5th ribs were resected in lengths of from one to three inches. The heart impulse was felt quite superficially in the posterior axillary line. The whole lung was diffusely and densely thickened.

The patient stood both operations quite well, temperature rising for a few days up to 100 and pulse up to 120. Respiration was somewhat quickened, up to 30, but within a week, on each occasion, temperature and respiration returned to the pre-operative level, though the pulse remained on the average about ten beats faster. The amount of sputum, however, was not diminished, although it became somewhat less purulent and more frothy. The amount varied from three to five ounces in twenty-four hours. On November 25th, Dr. H. B. Cushing reported as follows: "General condition good but appears more nervous than formerly. No signs of increased disease in right lung. Left chest markedly collapsed, especially in lower part. Skiagrams and physical signs indicate that little effect so far has been produced on the bronchiectatic cavities grouped around the root of the left lung. Heart in about the same position as before."

On November 27th she was given an autogenous vaccine of 50,000,000 which was not followed by any particular reaction, and on December 5th another dose of the vaccine of the same amount was given. This second dose was followed by a marked reaction, which did her some harm, temperature rising to 100, pulse to 110. She felt generally miserable, lost her appetite and had a little pain in the right upper chest, anteriorly, although Doctor Cushing could find no pleuritic signs to correspond. There was also slight cyanosis, and some increase of sputum. The anterior operation was postponed on this account for nearly two weeks, by which time she had largely recovered, although still not so well as before the vaccine. Pulse remained fast. Doctor Cushing thought this partly mechanical from pericardial adhesions drawing the heart up to the left axilla, and suggested that liberation of the pleura might relieve this interference with the heart action. X-rays showed some breaking down in the small area of consolidation at the bottom of the sound side, otherwise there was no change on that side. After considerable hesitation the anterior operation was decided upon. It was proposed to her, indeed, that she should go back to California and wait for six months or a year; to which she answered that if she went home she would never come back. On December 20th apicolysis was done. Muscle flaps were formed of the greater and lesser pectorals. The 2nd, 3rd and 4th ribs were resected in lengths of from 1 to 2½ inches. The base of the heart and the large vessels occupied the inner half of the space exposed, the lung being contracted towards the axilla. A thorough liberation of the lung was done anteriorly over the apex down to the 2nd rib behind and round the axilla till one met dense adhesions under the area exposed at the second posterior operation. These adhesions were too dense to separate without danger. The muscle flaps filled nicely the cavity created. The wound was closed without drainage.

This operation was badly borne, especially by the heart. The pulse immediately ran up to 140, respirations to 32, and they remained at about this level for two days, the temperature, however, keeping about normal. Under digitalis and heroin the heart steadied down, the pulse dropping twenty points. There appeared paradoxical respiration; and obviously some strain was being put on the other lung. The sputum was thick and the cough was unproductive. She vomited also frequently for thirty-six hours. It looked, however, at the end of the second day as if she were going to rally quite well, but at this point the temperature rose and on the third day reached 101.3, while respirations went up to 36 and pulse to 132. Some cyanosis appeared and Doctor Cushing found an area of impaired note over the right lower lobe behind with numerous crepitant râles, but no definite blowing breathing. This went on during the 4th and 5th days into an obvious broncho-pneumonia with infective bronchitis. She became more cyanosed, and on the 6th day she died from a filling up of the sound lung, and gradual exhaustion of the heart. Death was obviously due chiefly to an acute infective process in the sound lung, which was probably brought on by the mechanical strain put upon it by the operation, but was also due, in part at least and primarily, to the mechanical interference over the heart area and the loss of a certain amount of support from the side of the chest wall to which it was adherent, and to the interference with the respiratory movements of the diseased side. If she had not had, to start with, a mild infective condition in the bronchi of the sound side, she would probably have recovered, inasmuch as she had rallied quite well on the second day.

The lesson, therefore, is that we erred in taking a chance with a so-called "relatively healthy" lung which proved to be not healthy enough. It emphasizes the importance of demanding that the other lung shall be practically sound before one does an extensive thoracoplasty, or at any rate an apicolysis. In this case I



## UNILATERAL PULMONARY TUBERCULOSIS

ought to have refused to do the final stage of apicolysis, and should have insisted that she return home and wait for six months or a year in order to get stabilized again, recover from the ill effect of the autogenous vaccine and from any recent activity (suspected if not proved) in the sound lung, and allow the full development of whatever benefit the posterior operation might bring about. I believe that after that length of time fibrosis would have been materially advanced, and the right side might have become more certainly quiescent. And even if these hopes had not been realized, she would not have been any worse than before the operation.

CASE II.—Dr. W. H., aged fifty-five. Referred by Doctor Parfitt, of Gravenhurst. Admitted to the hospital, June 8, 1920. His disease was first diagnosed in 1910. After a year in Switzerland he continued his practice for three years, though with constant cough and expectoration. In 1916 he went to Gravenhurst and improved a great deal. Since then the course of his disease has been marked by a series of ups and downs, with frequent bouts of fever, and with gradual deterioration. Upon admission he was found to be in poor general condition. He was pale, and emaciated; his cough was very troublesome, his sputum was purulent, and measured from 4 to 6 ounces in a day. His whole left lung was diseased; there was a large cavity in the upper lobe, advanced fibrosis, and much retraction of the chest. The right lung was healthy, save for a slight arrested lesion at the apex. On account of his age and his poor condition I hesitated to operate, but, being urged by Doctor Parfitt, I decided to do so. On June 11, 1920, I removed from the 10th to the 7th ribs; and on July 7th the 6th to the 2nd. He made a slow convalescence, but cough and sputum steadily decreased, fever disappeared, and his pulse came down. About six months later I had from him an enthusiastic letter. He had improved steadily and had gained fifteen pounds in weight. His sputum was down to one ounce in the 24 hours; his pulse and temperature were steadily normal. Seventeen months after operation I heard from him again. His cough was practically gone; his sputum was less than half an ounce, and was constantly free from bacilli; he had no fever and had gained 26 pounds, and felt altogether well.

I need hardly relate in this place the histories of other cases. The two just given will suffice to teach the lesson, both of caution and of hope.

May I in conclusion give expression to the confidence which I feel that the profession possesses in this operation a valuable therapeutic means for the improvement and even the "cure" of a not inconsiderable number of the tuberculous who are not otherwise to be saved? I look forward confidently to a day not far distant when the State will fulfil its duty of caring for all its indigent tuberculous; and when in close connection with every sanatorium and in every city there will be found at least one surgeon who shall have made himself competent to operate upon such patients with the full measure of safety possible under the circumstances.

*Addendum, May 22, 1923.*—Since writing the above the number of cases has increased to 31. Of the last 16, one died some six weeks after operation of an aspiration pneumonia on the sound side. The results otherwise have been about the same as those above reported.

EDWARD ARCHIBALD

BIBLIOGRAPHY

- Friedrich: Arch. f. klin. Chir., 1908, vol. lxxxvii.  
Freeman: Tr. Amer. Surg. Assn., 1909, vol. xxvii, p. 116.  
Friedrich: Munch. med. Woch., 1911, No. 39 and 40.  
Friedrich: Med. Klin., 1912, No. 15.  
Sauerbruch: Munch. med. Woch., September 2, 1913, p. 1944.  
Sauerbruch and Elving: Ergebnisse der Med. und Kinderheilkunde, 1913, vol. x.  
Baer: Ztschr. f. Tuberk., 1914, vol. xxiii, p. 209.  
Tuffier: Interstate Med. Jour., 1914, vol. xxi, p. 259.  
Henschen: Tr. Amer. Surg. Assn., 1914, vol. xxxii, p. 547.  
Bull: Lancet, 1920, vol. ii, p. 778.  
Sauerbruch: Ztschr. f. Tuberk., 1921, vol. xxxiv, p. 687.  
Baer: Munch. med. Woch., December 9, 1921, p. 1568.  
Meyer: Surg. Gyn. and Obstet., February 30, 1920, p. 161.  
Whittemore: Boston Med. and Surg. Jour., September 1, 1921, p. 185-249.  
Frisch: Wien. klin. Woch., September 15, 1921, vol. xxxiv, p. 449.  
Shortle and Gekler: J. A. M. A., January 21, 1922, vol. lxxviii, p. 168.  
Sauerbruch: Die Chirurgie der Brustorgane, 1920.

## TUBERCULOSIS OF THE BREAST

By DAN COLLIER ELKIN, M.D.

OF BOSTON, MASS.

FROM THE SURGICAL SERVICE, PETER BENT BRIGHAM HOSPITAL, BOSTON, MASS.

WHEN we consider the enormous number of people affected with tuberculosis and compare this to the number of cases of tuberculosis of the breast reported in the literature we are at once struck with the rarity of the latter condition. There have been reported up to the present time about two hundred cases comprising about 1 per cent. of all breast diseases.

The first account of tuberculosis of the breast is due to Sir Astley Cooper,<sup>1</sup> who in 1829 described the macroscopic features of "scrofulous swelling of the bosom." Virchow, however, included the breast in the organs not affected by the disease. Dubar<sup>2</sup> was able in 1881 to prove microscopically that tuberculosis attacked the breast and that the disease here was similar to the condition elsewhere in the body, and in 1883 Ohnacker<sup>3</sup> succeeded in making a positive inoculation from the pus of a mammary abscess. In 1904 Auspach<sup>4</sup> reviewed the literature and compiled 77 cases reported up to that time, of which 42 were primary in the breast. In 1914 Deaver<sup>5</sup> reviewed the literature and compiled 74 cases reported between 1904 and 1914, including 5 personally observed, of which 45 were of the primary and 29 of the secondary type. Accepting only those in which tuberculosis was proven by microscopic section, only about 150 cases have been reported since 1881. Since 1914 Miles<sup>6</sup> has reported six cases, of which three were primary and three secondary. Gatewood<sup>7</sup> in 1916 reported 5 cases, of which three were primary and one secondary. Durante and McCarty<sup>8</sup> reported ten cases observed at the Mayo Clinic, of which three were primary. Hamilton<sup>9</sup> in 1920 reported a case of primary infection. To these we add seven observed at the Peter Bent Brigham Hospital between 1913 and 1922.

According to the usual grouping we have classified as primary tuberculosis of the breast, those in which no focus of the disease could be discovered elsewhere in the body, and as secondary those harboring the disease in some other part. Under such a classification five of our cases were primary and two secondary infection. However, to assume that tuberculosis is primary in the breast presupposes that the organism gained entrance through the skin or nipple or else through the blood stream without causing disease at the point of entry. That the tubercle bacillus can enter the body through the unbroken skin or pass through uninjured mucous membrane has been conclusively proven, but it is more than likely that most cases of so-called primary infection are really secondary to some unrecognized focus. For this reason, Gatewood,<sup>7</sup> suggests the terms "protopathic" and "deuteropathic" for the true primary infection and the type secondary to an unrecognized focus.

In the secondary variety, the primary focus is most usually located in the axillary lymph-nodes, the adjacent ribs, pleura, or lung. Infection from a

TABLE I.  
Summary of Cases, P. B. B. H., 1913-1922

Case number	Surgical number	Age	Type	Family history	Past history of tbc.	Nursing of children	Trauma at time of onset	Side	Location of quadrant	Sinus formation	Enlarged axillary glands	Other foci	Wassermann	Tubercle bacilli	Microscopic diagnosis	Treatment	Result
I	4983	36	Primary	Neg.	Neg.	No	None	R.	Upper inner	Present	Enlarged	None found	Neg.	Not found	Tbc.	Amputated breast. No axilla	Healed readily. Well with no recurrence, five years after operation.
II	5002	21	Primary	Neg.	Neg.	No	Def. history of blow	L.	Lower outer	Present	Not enlarged	None found	Neg.	Not found	Tbc.	Amputated breast	Primary healing. Well six years after operation.
III	7163	26	Primary	Neg.	Neg.	Yes	None	R.	Lower	Not present	Not enlarged	None found	Not done	Not found	Tbc.	Partial amputated breast	Good healing. Well two years after operation.
IV	10737	24	Secondary	Pos.	Neg.	No	None	L.	Lower inner	Not present	Enlarged	Rib	Not done	Not found	Tbc.	Excision tract and rib	Healed. Well for three years and no further breast condition. Tuberculous gland of neck excised five years later.
V	10273	23	Primary	Neg.	Neg.	Yes	None	L.	Lower inner	Present	Enlarged	Not found	Neg.	Not found	Tbc.	Amputation of breast. Dissection of axilla	Primary healing. Baby born one year after operation. Well with no recurrence eighteen months after operation.
VI	13988	37	Primary	Neg.	Neg.	At time of onset	None	L.	Upper outer	Present	Not enlarged	None found	Neg.	Found	Tbc.	Partial amputation	Good healing. Well three months after operation.
VII	17831	34	Secondary	Neg.	Neg.	Yes	None	R.	Central	Present	Not enlarged	Lung	Neg.	Not found	Tbc.	Amputation of breast	Primary healing. Well five months after operation.

## TUBERCULOSIS OF THE BREAST

contiguous focus, as the rib or sternum, by direct extension is not uncommon as in Case IV of our series. In the presence of axillary lymph-node involvement it is often impossible to tell whether the breast is primarily or secondarily involved. Illustrative of this point is the interesting case of Duvergey<sup>10</sup> quoted by Deaver.<sup>5</sup> The patient, while washing the linen of tuberculous patients, abraded a finger of her left hand. The wound suppurated for two weeks and then healed completely. Eight months later she noticed a swelling in the left axilla, which was incised and from which pus was evacuated. The wound did not heal and three months later a painful lump appeared in the left breast. This was drained and from time to time other



FIG. 1.—Surgical No. 17831. Tuberculosis of the breast, showing retraction of the skin and nipple with multiple discharging sinuses.

sinuses developed in the breast. The lungs eventually became involved and tubercle bacilli were found in the discharge from the sinuses. Here the evidence strongly points to retrograde lymph-vascular infection, but in our series, Case VI has been classed as primary although the axillary lymph-nodes may have been the primary seat of infection. With the exception of this case, only those cases of our series were classed as primary in which there was no other recognizable or even suspected focus, either by history, physical examination, or röntgenography. In all the diagnosis was definitely established by microscopic examination of the breast tissue and in addition the tubercle bacillus was demonstrated in the discharge from the sinus in Case VI.

*Predisposing Causes. Sex.*—It is essentially a disease of the female breast, only eleven male cases being reported. All our cases occurred in women.



FIG. 2.—Cut section of breast, showing numerous tubercles. Note the two abscess cavities and the sinus tract.

## TUBERCULOSIS OF THE BREAST

*Age.*—Eighty per cent. of the primary variety and 70 per cent. of the secondary collected by Deaver<sup>5</sup> occurred between the ages of twenty and fifty proving the correctness of von Eberts' statement "that the period of reproductive activity embraces the vast majority of cases." The youngest in our series was twenty-three and the oldest thirty-seven. Five of our patients were parous and had nursed children; one of them was lactating at the time of onset of symptoms.

*Heredity.*—A family history of tuberculosis was noted in only one of our cases and probably plays no more important rôle in tuberculosis of the breast than in the disease elsewhere.

*Trauma.*—The part played by trauma is that observed in surgical tuber-



FIG. 3.—Photomicrograph showing round cell infiltration and the presence of giant cells.

culosis elsewhere, in that a latent focus may be activated by the injury. Excepting the trauma coincident with nursing, only one of our cases gave a definite history of injury (Case II). In one of Scott's<sup>11</sup> cases, a tuberculous condition followed infection with a needle. Hamilton's<sup>9</sup> case was preceded by definite injury.

*Symptoms and Course.*—The most frequent initial symptom is a painless lump. This was observed in 65 per cent. of the primary and in 75 per cent. of the secondary cases collected by Deaver.<sup>5</sup> In five instances this was the first thing noticed by our patients. Pain, practically always present in the later stages, is comparatively rare at the onset, being present in only 9 per cent. of the primary type and in 7 per cent. of the secondary cases of Deaver's<sup>5</sup> series. In two of our cases it was the first thing noticed; in one, following trauma.

With rare exceptions mammary tuberculosis tends to suppurate early. After a few months, the lump softens, the adherent skin becomes red and thin, and finally, if not incised, ruptures spontaneously with the formation of a persistent sinus (Fig. 1), and perhaps at the same time or successively at various points other tracts develop until the breast is undermined and riddled with discharging sinuses, which run a chronic course with little tendency to heal.

At the same time the axillary glands increase rapidly in size and often present all the characteristics of tuberculous adenitis, but rarely suppurate.

We would emphasize as characteristic of this lesion the rapidity of growth of the abscess, the tendency to the formation of multiple fistulæ, and the early involvement of the axillary lymph-nodes.

Adherence of the skin and retraction of the nipple observed in a majority of reported cases were noticed four times in our series.

*Gross Pathology.*—Tuberculosis is almost invariably limited to one side, but simultaneous invasion of both breasts was noted by Albertin,<sup>12</sup> and successive invasion was observed in one case by Walther.<sup>13</sup> It is usually limited to one quadrant.

The process is fundamentally the same as in any organ, except for variations due to the structural peculiarities of the breast. With few exceptions all cases are embraced in three main types; (a) disseminated, (b) confluent, and (c) sclerosing.

Dubar<sup>2</sup> described a *forme disséminée*, and a *forme confluyente*, but it is probable that these are but two successive stages in the evolution of the same process. In the beginning, a segment of the breast may be studded with small irregular lumps, of firm consistency, with a yellow centre and a gray-blue periphery. These nodules remain distinct, or later join in forming a single nodular mass, undergoing caseation at the centre. Sometimes suppuration and fistula formation proceeds from small independent foci, or less often a large single "cold abscess" is formed (Fig. 2). Scott<sup>11</sup> described a type of "sclerosing tuberculous mastitis" characterized by diffuse sclerosis, in which the process either overlies deep abscesses or is deep to them, or more rarely where the whole lesion is essentially fibrous. In addition the breast may be involved as a part of a generalized miliary tuberculosis.

Prognosis depends largely upon the degree of involvement of other organs. Primary tuberculosis is practically always curable provided early and radical operation is carried out. With one exception all in Deaver's<sup>5</sup> series left the hospital apparently cured. All our primary cases are well from one to five years after leaving the hospital. One patient with secondary infection (Case IV) has had no recurrence in the breast but reentered the hospital after five years with suppurating tuberculous glands of the neck.

Treatment should be operative; amputation of the breast together with dissection of the axillary if the lymph glands are involved. Surgical treat-



## TUBERCULOSIS OF THE BREAST

ment of tuberculosis is not followed with such uniform success in any other part of the body.

*Conclusions.*—I. Tuberculosis of the breast is a comparatively rare disease as compared with tuberculosis elsewhere in the body.

II. Insofar as can be determined it may exist as a primary infection.

III. A breast abscess, with a tendency to the early formation of multiple fistulæ and with involvement of the axillary lymph-nodes, should make one suspicious of tuberculous infection.

IV. Treatment is operative and prognosis is good in primarily infected breasts, provided operation is early and radical.

### REFERENCES

- <sup>1</sup> Astley Cooper: *Illustrations of Diseases of the Breast*, London, 1829.
- <sup>2</sup> Dubar: *Thèse de doct.*, Paris, 1881.
- <sup>3</sup> Ohnacker: *Arch. f. Klin. Chir.*, 1883, vol. xxviii, p. 366.
- <sup>4</sup> Auspach: *Amer. Jour. Med. Sci.*, 1904, vol. cxxviii, p. 98.
- <sup>5</sup> Deaver: *Amer. Jour. Med. Sci.*, 1914, vol. cxlvii, p. 157.
- <sup>6</sup> Miles: *Edinb. Med. Jour.*, 1915, vol. xiv, p. 205.
- <sup>7</sup> Gatewood: *Jour. Amer. Med. Assn.*, 1916, vol. lxvii, p. 1660.
- <sup>8</sup> Durante and McCarty: *ANNALS OF SURGERY*, 1916, vol. lxiii, p. 668.
- <sup>9</sup> Hamilton: *S., G. and O.*, 1920, vol. xxx, p. 567.
- <sup>10</sup> Duvergey: *Jour. de Méd. de Bordeaux*, 1911, vol. xli, p. 841.
- <sup>11</sup> Scott: *St. Bartholomew's Hosp. Report*, 1905, vol. xl, p. 97.
- <sup>12</sup> Albertin: Quoted by Lenormant. *Precis de Path. Chir.*, Paris, 1914.
- <sup>13</sup> Walther: *Bull. et Mem. Soc. d'anat.* Paris, 1906, vol. xxxii, p. 1076.

# TUMORS OF THE BREAST—INNOCENT AND MALIGNANT

BY ALEXANDER PRIMROSE, C.M., EDIN.

OF TORONTO, ONTARIO

PROFESSOR OF CLINICAL SURGERY IN THE UNIVERSITY OF TORONTO

TEN years ago the writer presented a paper before the Canadian Medical Association on the subject of breast tumors. At that time 323 cases were reported for study. In the present paper 125 cases from one's private records have been added, making a total of 448 cases for the purpose of our present investigation.

In my former paper it was urged that the chief necessity in the study of tumors in the breast was to recognize malignancy early. To-day, that statement is made with still greater emphasis. In the last ten years, many suggestions have been made in the attempt to wrestle more effectively with this treacherous and terribly fatal disease. These suggestions have included attempts by improved technic to perform a more radical operation, and the more skilful use of radium and X-ray therapy. In spite of all efforts we are compelled to admit that we have no certain means of eradicating breast cancer once there is a primary growth in the breast with secondary metastasis in the adjoining lymph-nodes. To-day the greatest safeguard to the public is the early recognition and the early and thorough removal of the cancer growth. No radical measures in treatment can compete in effectiveness with the early diagnosis and immediate removal of the disease by operation.

In the past decade we believe the greatest progress which has been made in the treatment of cancer of the breast is found in the better education of the public and indeed of the profession regarding cancer. In former days it was not very uncommon to find doctors waiting for certain signs of malignancy before advising their patients to seek surgical intervention. Those days have gone by and we find the profession, as a unit, alert to recognize the earliest possible signs of malignancy and to secure immediate measures for radical relief. In doubtful cases there is no fatal temporizing but the diagnosis is cleared up without any delay by the surgeon and the pathologist. Then again the laity are better informed. They have come to realize that cancer in its early manifestations is a curable disease. We commend the work of the American Society for the Control of Cancer, which is accomplishing such excellent results. The institution of an annual "cancer week" when, in an intensive fashion, the public are instructed, is to be commended as a most effective measure for controlling the ravages of this disease.

Summary of cases under revision:

## TUMORS OF THE BREAST

The number of cases previously reported and analyzed ..... 323  
 To which for the purpose of this paper are added an additional number  
 from my private cases ..... 125

Making a total at present under investigation ..... 448  
 Classified as in previous paper as follows:—

<i>Malignant Growths.</i>	Previously reported	New cases	
Carcinoma .....	212	74 =	286
Sarcoma .....	4	1 =	5
		—	291
<i>Benign Growths.</i>			
Fibro-adenoma .....	75	19 =	94
Chronic mastitis .....	32	28 =	60
Lipoma .....		1 =	1
Tuberculosis .....		2 =	2
		—	157
Total.....			448

### STATISTICS OF THE ENTIRE GROUP OF CASES

*Malignant Cases. Age.*—In malignant cases the oldest patient in previous series operated upon was 78 years of age and the youngest 28. In my recent series the oldest patient operated upon was 80 and the youngest 31.

The average age in previous cases was 49.2 years and in the recent cases 49.6 years.

Taken in decades the following comparative study was made.

	Old series.	New series.	Total cases.
30 and under .....	3.4%	0%	2.4%
31 to 40 inclusive .....	17.5%	24.6%	21.0%
41 to 50 inclusive .....	40.0%	32.8%	36.4%
51 to 60 inclusive .....	19.0%	19.1%	19.0%
61 to 70 inclusive .....	14.0%	16.4%	15.2%
70 and over .....	5.6%	5.0%	5.3%

*Benign Cases.*—In benign cases the oldest patient operated upon in my previous series was 61 years of age and the youngest was aged 19. In my more recent series the oldest patient operated upon was 58 and the youngest 11 years of age.

The average age in previous series was 37 years and in my recent series 37.2 years.

Taken in decades the following comparative table was constructed:

	Old series.	New series.	Total cases.
20 and under .....	3.0%	6.0%	3%
21 to 30 inclusive .....	23. %	14. %	18.5%
31 to 40 inclusive .....	38.5%	46. %	42.3%
41 to 50 inclusive .....	27.7%	26. %	26.9%
51 to 60 inclusive .....	6. %	8. %	7. %
over 60 .....	5.6%	0. %	2.3%

Tumors of the breast may be inflammatory in origin or they may be new growths. Mastitis is exceedingly common, both acute and chronic, with or without suppuration. Tuberculosis, syphilis and actinomycosis constitute the rarer forms of specific breast infection resulting in tumor formation. By

far the most common malignant growth in the breast is cancer, while sarcoma occurs as a very rare event. Of the benign growths we have adenomata or fibro-adenomata, and much more rarely such tumors as angioma, myxoma and lipoma. The tendency to cyst formation in tumors of the breast is very marked, and is found both in inflammatory conditions and in new growth. The relationship of cysts and papillomata in the breast to the subsequent development of new growths has been recently studied by Sir George Cheatele. He has shown the relationship which exists between cystic and epithelial changes, on the one hand, and the development of a new growth of a simple or malignant type on the other. The technic which Cheatele employed was to make whole sections of the entire breast with a very large microtome and to study the relationship of cyst formation to the gland ducts and the gland acini along with the epithelial hyperplasia accompanying the cyst formation. He showed very conclusively that the cystic state acted as a predisposing and determining cause in the initiation and growth of tumors both simple and malignant. In a paper published by Bloodgood a few months ago, we have his views on benign lesions of the female breast for which operation, in his opinion, is not indicated. He reports 267 cases of this nature which have come under his observation. With many of his conclusions we agree, for example there could be no difference of opinion as to his good judgment in refusing to operate on 50 women who had pain and 22 cases with painful scar, in both series without tumor. We have no doubt in our mind that circumstances might justify him in refusing to operate on 17 cases of tumors of the axilla including aberrant breast tissue, lipoma, lymph-glands, tumors of the sebaceous and sweat-glands; nor again do we question his judgment in refusing to operate on 15 cases of hypertrophy of the breast. In fact, in the whole series we are in entire agreement with the exception of one most important group. We refer to 64 cases of "definite and indefinite, single and multiple tumors in one or both breasts in women over twenty-five years of age." Doctor Bloodgood gives his reasons why he refused to operate in these cases. The 64 cases represent, it is true, but a small number of the total cases treated, this is obvious, for example, when he states that "in almost 3000 cases of breast lesions" there were "but five cases in which . . . a single definite tumor in one breast in a woman at the cancer age" existed and in which operation was refused. Nevertheless, our experience, though much less extensive than Doctor Bloodgood's, affords ample evidence that the teaching implied in his communication is to be questioned. The doctrine is in our humble opinion unsound. We cannot analyze the details of his cases to the extent we would wish in this present paper, but we consider he is too dogmatic in his assertions regarding the harmless nature of dilated ducts and simple cysts. Cheatele's work, already referred to, has demonstrated a direct relationship between cysts and malignancy. Again while, in Bloodgood's words, "multiplicity, of multiple tumors is suggestive of benignity," these multiple tumors at the cancer age must invariably be looked upon with grave suspicion. One single example will suffice from my series.

## TUMORS OF THE BREAST

A married woman thirty-three years of age: Both breasts presented a firmly nodular diffuse condition, the axillary glands were palpable on both sides: Both breasts and the axillary glands were removed at one operation; the right breast tissue when examined under the microscope showed medullary carcinoma with metastases in the lymph-glands, the left breast showed no evidence of malignancy in either breast or glands. Twenty-nine months after operation, she presents herself with metastases in the supra-clavicular glands of the right side.

Such a case to my mind proves a very definite relationship between chronic inflammatory conditions in the breast (chronic mastitis) and malignancy: the latter is often the precursor of carcinoma. This is illustrated in many of my cases, thus, for example, a woman of thirty-three who was operated upon for cancer of the right breast, gave a history of a number of hard lumps which had existed in the breast for six or seven years. This patient died subsequently from recurrence.

Then again, in contending that simple cysts in women under twenty-five are not dangerous, we would refer to the following case:

A single woman aged twenty-three, had a lump in the right breast to the outer side of the nipple, along with a more or less diffuse nodular thickening, no glands were palpable in the axilla. The breast was removed. The section under the microscope showed dilated ducts filled with cells; one can trace all stages in a papillomatous development of these cells, at no point however did the cell hyperplasia burst beyond the basement membrane, nor were there any mitotic figures. The pathologist reported it as a "precancerous condition." Can anyone question the wisdom of removing such a breast?

We must therefore protest against the teaching of Bloodgood and favor rather that implied in the aphorism of his colleague Doctor Finney, when he said, "Any lump in any woman's breast is better out than in."

In my recent series of 125 cases there were 15 requiring removal of both breasts by operation. These were as follows:

Cancer in both breasts .....	11 cases
Cancer in one breast, chronic cystic mastitis in other breast.....	2 cases
Chronic cystic mastitis in both breasts .....	2 cases
<hr/>	
Total .....	15 cases

Of the eleven cases with amputation of both breasts there was only one instance in which both breasts were removed at the same sitting for bilateral development of cancer. There was an interval in all other cases between the first operation and the occurrence of disease in the second breast demanding operation. The shortest interval was eight months and the longest six years and ten months. The following table indicates the facts in greater detail regarding the 11 cases of cancer in both breasts.

# ALEXANDER PRIMROSE

	Age at last operation	Interval between operations	Note on individual case.
No. 1	40	Both breasts at one sitting.	Right breast showed medullary type of cancer. Left breast was scirrhus in type. She died 14 months subsequently with metastasis in lungs
No. 2	35	8 months	She exhibited metastasis in spine 15 months after last operation.
No. 3	39	1 year	Died of recurrence 10 months after last operation.
No. 4	42	1 yr. 4 mos.	
No. 5	57	1 yr. 6 mos.	
No. 6	80	1 yr. 10 mos.	
No. 7	54	2 years	Both Paget's disease of the nipple.
No. 8	56	2 yrs. 1 mo.	
No. 9	43	2 yrs. 2 mos.	
No. 10	52	2 yrs. 8 mos.	
No. 11	45	2 yrs. 10 mos.	Five years after last operation developed bone metastasis in ribs and sternum.

Of the two cases showing benign conditions on one side and cancer on the other, the following is the summary :

No. 1	33	Both operations at one sitting	Right breast showed cancer with metastasis in lymph glands. Left breast no malignancy but chronic cystic mastitis. A year afterwards she returns with metastases in supra-clavicular glands of right side.
No. 2	39	8 years and 10 months	First breast removed showed chronic cystic mastitis. Second breast a scirrhus cancer.

Of the two cases of removal of both breasts for chronic mastitis; in one a woman of twenty-eight, both breasts were removed at one sitting. In the other, there was an interval of three years and four months.

In 74 cases of breast cancer therefore there were eleven in whom cancer developed in the opposite breast, *i.e.*, 15 per cent. Of these only one exhibited cancer synchronously in both breasts. The others occurred at varying intervals. In two of the 74 cases there was cancer in one breast and chronic cystic mastitis in the other.

Kilgore, in a careful analysis of a large series of cases, has deduced the formula that "The patient who has had one breast amputated for cancer is, if she survives five years, from three to four times more likely to develop

cancer in the second breast than a normal woman of the same age in either of the breasts." He also believes that the majority behave as primary in the second breast and not as metastatic. He suggests also that his findings indicate the prophylactic removal of the second breast or redoubled care in observation of the second breast after operation on the first.

In a previous paper one analyzed in some detail the clinical manifestations of malignancy. It is not necessary to repeat these observations, but one must urge the necessity for a most thorough technic in the examination of the patient. Carefully studied, it is almost invariably possible to make a bedside diagnosis. It should not be necessary and may result in error to trust to the so-called "quick section" at the time of operation. I have elsewhere discussed this phase of the question at length.

I do not propose in this paper to discuss the technic of the operation for the radical removal of breast cancer. The principles involved in all effective methods involve the complete removal both of the primary growth and of the group of lymphatic glands receiving the efferent lymphatics of the breast. This will necessitate the removal of the costo-sternal portion of the pectoralis major and the pectoralis minor.

Treatment of cancer by X-ray and radium is attracting the attention of all practitioners of medicine. In all clinics, over the entire country, either one or the other or a combination of these radioactive agencies is being used either as a primary and sole method of treatment or as a treatment additional to the operation. We are convinced at the present time removal by operation holds out the best prospect of cure. In the clinic at Toronto, radium and X-ray are used as adjuncts to surgery and are employed in some instances prior to operation but chiefly, in intensive dosage, subsequent to the radical operation. Most if not all surgeons to-day hold the view that X-ray and radium should be utilized only as adjuncts to surgery. (Greenough, Bowing, etc.). We trust the employment of such agencies will prove a most potent factor in the cure of the disease.

Curiously enough we have observed that X-ray treatment will, in some instances at all events, relieve the pain in bone metastases, but as yet we are ignorant of the effect produced upon the progress of growth in such secondary deposits.

It would hardly seem necessary to emphasize the importance of a careful microscopic examination, of all tumor removed from the breast. Twenty years ago it was not uncommon to find incomplete operations without histological examination. To-day most practitioners are alive to their responsibility in that respect, and yet I find three cases out of seventy-four (4 per cent.) operated upon within recent years in which "a lump" had been removed without a pathological diagnosis and the patient comes back in a few months with advanced carcinoma! This surely is worthy of the most severe condemnation and does not reflect credit upon those who are guilty of such unpardonable neglect.

For the purpose of studying end results the writer has taken 76 consecutive

# ALEXANDER PRIMROSE

cases from his private records. These cases were all operated upon more than five years ago and are therefore available for study as to "five-year cures." The classification of Greenough has been adopted as follows:

## ENDS RESULTS—CARCINOMA OF THE BREAST

A. Total entries—carcinoma breast .....	76
B. Re-entries (entered more than once) .....	3
C. Recurrence from previous operation .....	6
D. Cases available for study of operability, mortality, etc. ....	67
E. Radical operation .....	51
F. Palliative operation .....	7
G. No operation .....	9
H. Operative deaths .....	0
I. Operative mortality ( $H \div E + F$ ) .....	0
J. Operability: Radical operations ( $E \div D$ ) .....	76 %
K. Operability: All operations ( $E + F \div D$ ) .....	86.5%
L. Inconclusive cases. Lack pathological examination .....	0
M. Inconclusive cases: Untraced .....	6
N. Inconclusive cases. Died within time limit without recurrence .	0
O. Cases available for end-result data .....	61
P. Radical operations .....	45
Q. Palliative operations .....	7
R. No operation .....	9
S. Number cases alive and well .....	19
T. Number of cases died without recurrence (over 5 years) ....	1
U. Number 5 year "cures" (all operations) .....	20
V. Number 5 year "cures" (radical operations) .....	20
W. Percentage of "cures" (all operations) ( $U \div P + Q$ ) .....	38.4%
X. Percentage of "cures" (radical operations) ( $V \div P$ ) .....	44.4%

## CLASSIFICATION OF END-RESULTS IN FORTY-FIVE RADICAL OPERATIONS

	Cases	Cures	Percentage of cures.
1. Early favorable (no glands involved) .....	11	10	91%
2. Favorable (glands slightly involved) .....	13	8	61%
3. Average cases (glands markedly involved) ....	21	2	9%

Greenough and Simmons report a five-year "cure" in 32 per cent. of 69 patients submitted to radical operation for primary cancer of the breast. Sistrunk, in an analysis of 218 cases, found that in 132 of these cases in whom the lymph-glands were involved only 19 per cent. were alive 5 to 8 years after operation, whereas of 86 patients operated upon before the glands were involved, 64 per cent. were alive 5 to 8 years afterwards.

Peck and White give the following end results in 69 cases of malignant tumor of the breast:

Alive and well more than 5 years .....	39%
Alive and well more than 5 years; cases with metastases .....	23%
Alive and well more than 5 years; cases without metastases ....	65%

Of recent years, attempts have been made to judge of end results, by fixing an arbitrary number of years of life after operation as indicating a cure.



Most statisticians have worked upon a three to five-year basis. The information thus obtained is of undoubted value, but it is not absolutely conclusive, a fact well recognized by all. Even in extensive disease it is often remarkable how long a patient will survive a radical operation. Thus in a patient with the entire breast implicated and ulceration beginning, the radical operation was performed and she lived four years, dying eventually from recurrence. Again I have the remarkable history of a woman of sixty-three who had an operation for cancer of the right breast in November, 1916. This woman is still alive, over six years after operation; she has a recurrent mass in the axilla and secondary metastasis in nearly every bone of her skeleton. Her history will be described in greater detail later in our consideration of bone metastases.

Sampson Handley made an important contribution to this subject in his investigations regarding the secondary manifestations of breast cancer. His work, which is familiar to all those interested in the subject, was first presented in the Hunterian lectures before the Royal College of Surgeons in 1905; subsequently he published more extended observations in book form. He enunciated the view of continuous extension of growth along lymphatic channels and termed it "lymphatic permeation." This view was opposed to the "embolic" theory of the origin of secondary growths. His findings may be summarized as follows: He demonstrated continuous extension of cancer cells along lymphatic channels to the glands of the axilla and to the infra-clavicular and supra-clavicular groups. He also traced a continuous chain of invasion to the pleura, the lungs, and to the opposite breast. He similarly accounts for bone metastases in the humerus, the ribs and the spine. Perhaps his most interesting observation is the invasion of the lymph channels from the breast to the epigastrium and the navel, hence, by the lymphatics of the round and falciform ligaments cancer cells may bud off and become free in the peritoneal cavity and may lead to distant metastases in the intestine or in the ovary, the cancer cells being carried thither by the movements of the stomach and intestines or by gravity. The lymphatics of the diaphragm may be reached along the epigastric route and thus the rare implication of the retro-peritoneal lymph-glands and of the kidney is explained. Thus in the long-standing cases of breast cancer these distant metastases are brought about, according to Handley, by continuous invasion along lymphatic channels.

There is some confusion regarding the significance of palpable glands in the axilla in a case of breast tumor. We regard it as one of several local signs suggestive of carcinoma and yet induration and enlargement of axillary glands are by no means pathognomonic of malignancy. Ewing would have us believe that the lymph-nodes undergo a process of change antecedent to the actual development of secondary metastasis; he states that for months or weeks the soil is prepared in lymph-nodes draining a primary focus of carcinoma. He describes the more recent changes as consisting of moderate swelling of the gland, diffuse hyperplasia, catarrhal exfoliation of sinus endothelium, multiplication of follicles, not uncommonly at a later period the nodes become

atrophic and fibrous and may become extensively invaded by fat. The more recent changes he attributes to the absorption of toxic products from the tumor, autolytic and bacterial. This conception is not wholly in consistence with clinical observation. The changes in a lymph-gland antecedent to the production of a secondary growth are more likely to be synchronously developed with and dependent upon changes in the breast which are antecedent to the development of a carcinoma in the breast. We frequently find such inflammatory hyperplasia in the glands in cases of chronic mastitis and we believe such cases often develop cancer both primary and secondary. The following case illustrates my point. A woman aged thirty-three had a nodular diffuse involvement of both breasts with enlarged palpable glands in each axilla. Both breasts were removed with the axillary contents. The right breast gave a typical histological picture of medullary cancer with metastases in the axillary glands: the left breast was the seat of chronic mastitis, the glands showing inflammatory changes, but neither in the breast nor in the glands was there any evidence of malignancy.

The palpable axillary gland may, in some instances, give us the chief evidence of the true nature of the case. In a woman of forty-nine a radical operation was performed on a clinical diagnosis of breast cancer. The pathologist reported chronic mastitis without malignancy. Through an accidental circumstance the axillary glands were lost sight of and were not examined for some days subsequently: undoubted cancer was found in the glands; the breast was again carefully searched, and eventually a small focus of malignancy was found, surrounded by a large area of chronic inflammatory change. Among other things this illustrates the futility of trusting to a quick section in such a case.

On the other hand, carcinoma of the breast may in rare instances be responsible for distant metastases while the local lymph-glands escape. A woman, thirty-nine years of age, came to me with a metastatic growth in the spine. This woman had had the right breast removed three years previously for a tumor which histologically was considered cancer. The axillary lymph-glands had never been disturbed and never showed any signs of involvement. It is possible the late changes in the lymph-glands, described by Ewing and quoted above, may be responsible in some instances for failure of the metastatic processes to develop in the lymph-gland. The atrophic, fibrous and fatty changes in a gland may so interfere with its function as a filter that the cancer cells fail to take lodgement in the gland. These atrophic changes in the gland may have occurred as the result of inflammatory processes in the breast prior to the development of the primary cancer growth.

Clinically, when a diagnosis of a primary carcinoma has been made, we must always assume the involvement of lymph-glands even if there is no gross manifestation of the fact: our modern radical operation for breast cancer is devised to meet such an hypothesis.

If the primary growth is extensive and advanced the lymph-nodes rarely, if ever, escape, and these are noticeable in the gross. In fact, the absence of

the gross involvement of lymph-glands at operation in a case exhibiting evidence of advanced and extensive malignant disease should lead us to doubt the accuracy of our diagnosis.

The implantation and dissemination of cancer during our operative procedures is a danger which must be guarded against in our operative technic. This danger exists, for example, in our operations for breast cancer. It is a very real danger in the manipulation of the cancerous breast prior to the operation or in the method of scrubbing and preparing the parts to secure an aseptic field. There is a strong argument here also against the employment of the "quick section" for diagnostic purposes at the time of operation. The writer has long held these views and has insisted upon the greatest gentleness in manipulating a cancerous breast both before and during operation. Dr. Leila Charlton Knox has recently published a paper on "The Relationship of Massage to Metastasis in Malignant Tumors." She carried out numerous experiments in mice; for example, in one series the animals were inoculated subcutaneously in the inguinal or axillary region with mouse carcinoma; the resulting tumor, when it reached the size of 5 mm. in diameter, was vigorously massaged for one minute on two consecutive days; the tumors were then excised and the animals killed twenty-seven days later. In a large percentage of the cases metastases were found in the lungs. In another series of experiments very gentle massage, carried out every day for a fortnight, with similar findings. Experiments of this nature are instructive and suggestive, the results obtained are quite in harmony with our knowledge of the dissemination of cancer in man.

*Bone Metastasis.*—One of the most interesting phenomena in the course of malignant disease is the occurrence of metastases in bone. The bone may be invaded by direct spread from the primary growth. In breast cancer, for example, we may have involvement of the ribs and sternum. According to Sampson Handley more distant bones may be reached (humerus, spine, etc.) by direct extension through lymphatic channels; one of his arguments in this connection is the immunity of the bones below the elbow and below the knee, such cases being too distant for lymphatic connection. On the other hand, he traces lymphatics to the deltoid insertion of the humerus, and to the great trochanter of the femur as the most likely points of entrance for these bones. Schmorl, on the other hand, considers the pathway to be by the blood stream.

Bone metastasis in cancer is much more common than was hitherto believed. Von Recklinghausen made a careful study of cancer growth in bone in 1891. Sir Henry Thompson, as early as 1854, reported a case of carcinoma of the prostate with metastasis in the spine. Schmorl of Dresden was one of the first to remark upon the very great frequency of its occurrence. According to this authority the metastatic growth may only be discovered by microscopic examination, but in the vast majority of cases it is distinguishable in the gross. Schmorl finds that of all cases of cancer coming to autopsy no less than 34 per cent. show metastases in bone. In late years the X-ray has

proved of great value in determining the diagnosis, and has demonstrated the frequency of its occurrence.

I have a number of cases in my series of which I may cite a few examples. There were two cases of mammary cancer in which metastases occurred in the cranial diploe. A comparatively common locality was the cancellous bone of the body of a vertebra.

As an example of metastasis in the spine I might mention the following case with a somewhat unusual history. A woman of thirty-nine had her right breast removed three years before she came under my observation. The nature of the trouble in the breast at that time was somewhat doubtful; it was supposed to be "chronic mastitis," but the report of the pathologist suggested probable malignancy. The axillary glands were not removed. A year and a half subsequently she complained of abdominal pain and pain in her back. As the result of the findings in an X-ray series after a barium meal her appendix was removed. She insisted, however, that her "back was broken" and in truth she was right. Three years after the removal of the breast a stereoscopic picture obtained by the X-ray showed an almost complete destruction of the body of the fourth lumbar vertebra, with less extensive involvement of the twelfth dorsal, and fifth lumbar and the upper part of the sacrum. It was a purely destructive process with no new bone formation and without any invasion of the intervertebral discs which remained intact. This patient, therefore, showed metastasis in the spine three years after the removal of a breast carcinoma and the remarkable fact remains that the axillary lymph-nodes were never involved and were not removed.

One of my patients exhibited multiple bone metastases at widely separated parts of the skeleton. A woman sixty-three years of age was operated upon for cancer of the breast with two subsequent operations, during the next three years, for recurrence in the axillary glands. Three years and a half after the first operation she was treated by an osteopath for "rheumatism" of the right hip. She had lost weight. Shortly after this she came to hospital when we discovered metastases in the upper part of each femur, the ribs, the humerus and the cranial diploe. This woman is still living, five and a half years after the breast was amputated and two years since the multiple secondary growths in the bone were discovered. She now has a large mass of recurrent growth in the axillary glands.

The course of events in the bone at the seat of a secondary carcinoma are of interest. Bone is destroyed at the seat of the growth and spontaneous fracture of a long bone may occur. In this event, under suitable conditions of rest and splinting, callus may be formed and union may occur. In other instances destruction of the entire thickness of a bone may involve a considerable portion of a shaft and union becomes impossible. The tumors are frequently multiple. A study of these cases would lead one to assume that in many cases a secondary growth of cancer in bone remains more or less dormant for long periods of time. The tumors do not, as a rule, grow to great size, they are confined within the bone, and do not tend to invade the

## TUMORS OF THE BREAST

soft structures beyond. In time, however, the surrounding tissues may be infiltrated and increased rapidity of growth ensues.

Metastatic tumors in bone may be present without being suspected by either the patient or her medical attendant; in many instances their existence has only been discovered accidentally. The complaint of pain in various parts of the skeleton, particularly in the spine in patients suffering from cancer, arouses suspicion, and an investigation by the X-ray should be undertaken. Treatment of these cases by the radiologist may possibly be of some service. It is impossible to make any definite statement in this regard, but certain cases would appear to be relieved of pain and to improve in general health under this treatment.

In the beginning of my paper I stated that by far the most important observation in studying the course of mammary carcinoma is regarding the duration of the disease at the time of operation. I complete my paper by a further reference to this subject. One can assert that the greatest advance in the past decade, in securing improved results and in saving life, lies in the fact that patients come earlier to the surgeon for treatment. That patients do come earlier is obvious in studying the following comparative statement of the average duration of disease at the time of operation in the old series prior to 1912 and to new series of cases under treatment in the last ten years.

AVERAGE DURATION OF DISEASE AT TIME OF OPERATION.

<i>Malignant Growths.</i>	Old series	New series.
Average Duration	14.375 months.	12.75 months.
Those who came to operation under one year .....	54.5%	76.8%
Those who came to operation under six months .....	35.4%	53.6%
Those who came to operation under three months .....	19.0%	37.5%
Those who came to operation one month and under one month from initial symptoms .....	8.4%	27.0%

This result may in part, at all events, be attributed to the work of the American Society for the Control of Cancer. We fondly hope that further advances will be made in our knowledge of the nature of cancer, in our methods of diagnosis, and in improved treatment by operation or otherwise, but we feel assured that by far the most effective means of saving life and ameliorating suffering in breast cancer at the present time lies in the early diagnosis and prompt removal of the disease by radical means.

### REFERENCES

- Bloodgood, Joseph Colt: Benign Lesions of Female Breast for which Operation is not Indicated. *The Journal of the American Medical Association*, vol. lxxviii, March 25, 1922, p. 859.
- Bloodgood, Joseph Colt: The Pathology of Chronic Cystic Mastitis of the Female Breast. *Archives of Surgery*, vol. iii, p. 446, November, 1921.
- Bowing, H. H.: Topical Applications of Radium. *Collected Papers of the Mayo Clinic*, vol. xli, 1920, p. 1207.

- Cheatle, Sir G. Lenthal: Cysts, and Primary Cancer in Cysts of the Breast. *The British Journal of Surgery*, vol. viii, No. 30, October, 1920, p. 149.
- Cheatle, Sir G. Lenthal: A Further Contribution to the Study of Cysts and Papillomata of the Breast. *The British Journal of Surgery*, vol. ix, No. 34, October, 1921, p. 235.
- Cheever, D.: Tuberculosis of the Mammary Gland. *Surg. Clin. North Am.*, vol. i, p. 919, June, 1921.
- Davis, Bryan B.: Cancer of the Breast. *Archives of Surgery*, vol. iii, p. 348, September, 1921.
- Ewing, James: *Neoplastic Diseases*, 1919.
- Ewing, James: The Treatment of Cancer on Biological Principles. *New York Medical Journal*, October, 1912, p. 773.
- Greenough, R. B., and Simmons, C. C.: End Results in Cancer Cases. 'Cancer of the Breast. *Boston Medical and Surgical Journal*, vol. clxxxv, p. 253, September 1, 1921.
- Greenough, R. B.: Ninth Annual Report of the Collis P. Huntington Memorial Hospital for Cancer Research and of the Laboratories of the Cancer Commission of Harvard University, 1920-21, July 1, 1921.
- Halsted, W. S.: The Swelling of the Arm after Operations for Cancer of the Breast. *Elephantiasis Chirurgica: its Cause and Prevention*. *Bull. Johns Hopkins Hospital*, vol. xxxii, p. 309, October, 1921.
- Hadley, W. Sampson: *Cancer of the Breast and its Treatment*. Second Edition, 1922.
- Kilgore, Alson R.: The Incidence of Cancer in the Second Breast after Radical Removal of one Breast for Cancer. *Journal American Medical Association*, vol. lxxvii, p. 454, August 6, 1921.
- Kilgore, Alson R.: Is Paget's Disease of the Nipple Primary or Secondary to Cancer of the Underlying Breast? *Archives of Surgery*, vol. iii, p. 324, September, 1921.
- Knox, Leila Charlton.: The Relationship of Massage to Metastasis in Malignant Tumors. *ANNALS OF SURGERY*, February, 1922, p. 129.
- Mileff, S.: Clinical Aspects of Actinomycosis of the Breast. *International Clinics*, vol. iii, p. 29. Series 31, 1921.
- Mills, G. Percival: The Prognosis of Carcinoma Mammæ: A Review of 169 Cases. *British Journal of Surgery*, vol. ix, p. 91. July, 1921.
- Peck, Charles H., and White, W. C.: Tumors of the Breast. *ANNALS OF SURGERY*, vol. lxxv, June, 1922, p. 641.
- Percy, J. F.: A New and Advanced Surgical Treatment for Breast Cancer. *Surgery, Gynecology and Obstetrics*, vol. xxxiii, p. 417. October, 1921.
- Primrose, A.: Breast Tumors, with Special Reference to Carcinoma. *American Journal of the Medical Sciences*, January, 1913, vol. cxlv, p. 100.
- Schmorl, G.: Ueber Krebsmetastasen im Knockensystem. *Centralblatt für Allgemeine Pathologie und Pathologische Anatomie*. *Ergänzungsheft Zum xix Bande*, 1908, p. 89.
- Schmorl, G.: Ueber Krebsmetastasen im Knockensystem und sarcomatöse Denegeration derartiger Metastasen. *Centralblatt für Allgemeine Pathologie und Pathologische Anatomie*, vol. xix, 1908, p. 405.
- Sistrunk, W. E.: Cancer of the Breast with a study of the Results Obtained in 218 Cases. *Pennsylvania Medical Journal*, vol. xxiv, p. 781, August, 1921.
- Thompson, Henry: Carcinomatous Deposit in Prostate Gland within the Spinal Column, etc. *Transactions Pathological Society of London*, vol. v, 1854, p. 204.
- Winslow, Randolph: An Analysis of 102 Cases of Tumors of the Breast. *ANNALS OF SURGERY*, vol. lxxiv, p. 341, September, 1921.

## RANULA\*

BY VILRAY P. BLAIR, M.D.

OF ST. LOUIS, MO.

FROM THE SURGICAL DEPARTMENT OF WASHINGTON UNIVERSITY MEDICAL SCHOOL

THERE is no commonly occurring instance of abnormal anatomy about which such vague theories are prevalent than ranula. The mucoid cysts that occur in and about the floor of the mouth can be roughly divided into two classes. There are a number of different kinds of relatively small cysts that appear to lie in, or just under the mucosa of the floor of the mouth or under the surface of the tongue which tend to protrude frankly into the mouth; they are in my observation comparatively rare, small in size and their complete excision is a simple matter. These have origin from various mucous or submucous glands and their chief surgical interest comes from the confusion that has arisen from not drawing a sharp distinction between these and the more common type of ranula which lies in the floor underneath the mucosa and submucous tissues and whose chief characteristic is what Doctor Thompson has called a burrowing quality. These may push the tip of the tongue and the mucosa of the floor upward and backward, but the greater bulk always lies buried deep in the tissues of the floor. The amount discernible from within the mouth is no indication of its real size and their complete removal may be very difficult or even surgically impracticable. The most commonly accepted hypothesis has been that such were obstruction cysts of the sublingual gland. This presupposes a unique reaction to the sublingual obstruction and such an explanation for submaxillary, submental and parafaucial ranulae, seems still more unreasonable. I believe that the theory of obstruction of the submaxillary duct or dilation of a Fleishman's bursa can be dismissed without comment.

Doctor Thompson's hypothesis, that the deep ranula and related cysts originate from migrated portions of the cervical sinus, is sufficiently broad to explain all hitherto observed types. In his original communication † Doctor Thompson gives a very lucid explanation of the manner and cause of this migration. (Fig. 1.) I have come to accept his view, not so much because it may or may not be correct, but because it furnishes a logical basis for adequate surgery. When you attempt to attack a ranula from within the mouth and find that it extends up to the base of the skull as a parafaucial cyst, as happened in two of our cases, or that a process extends an indefinite distance into the neck as happened in another, or find the ranula to have a submental extension, then thinking in terms of the sublingual gland

---

\* Read before the Southern Surgical Association, December 14, 1922.

† The Relationship Between Broncho-Genetic and Ranula Cysts, *ANNALS OF SURGERY*, vol. lxxii. p. 164, 1920.

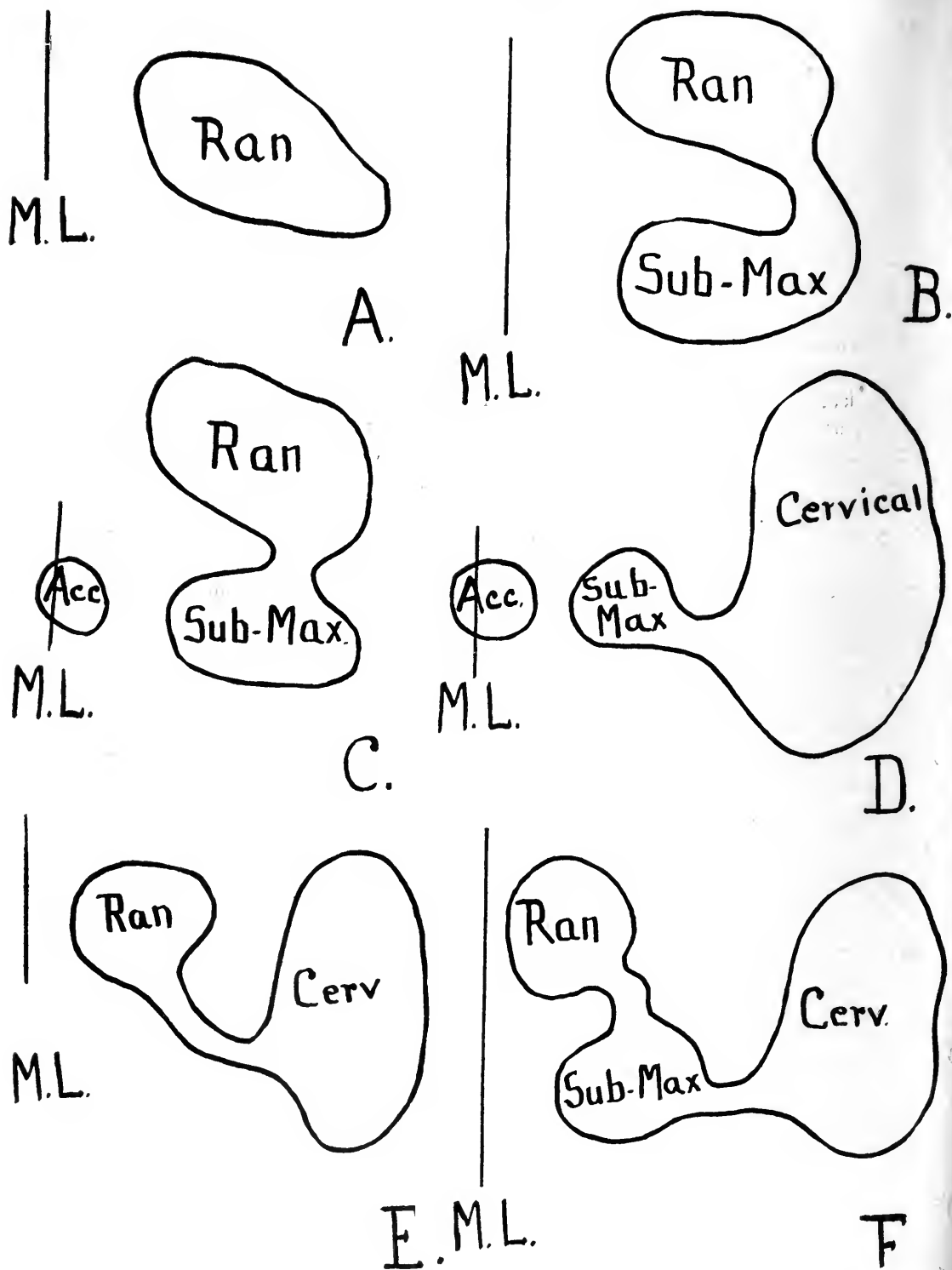


FIG. 1.—Doctor Thompson's original diagram, to illustrate the origin of the various types of deep ranula that he observed and which led him to conclude that these were all derived from the cervical sinus. A diagrammatic representation of the anatomical distribution of the cysts met with in the deep cervical, submaxillary and sublingual regions. A, represents a simple ranula. B, a ranula and submaxillary cyst communicating with one another by a neck. C, a ranula and submaxillary cyst communicating with each other; also a small isolated cyst in the submental region. D, shows a deep cervical cyst communicating with a submaxillary cyst; also an isolated submental cyst. E, shows a deep cervical cyst communicating with a ranula by a long narrow neck which traverses the submaxillary region. F, shows a deep cervical cyst communicating with a submaxillary cyst, which in turn opens into a ranula. The letters M. L. mean "middle line of the neck." For purposes of comparison all the cysts have been drawn on the left side of the body. (ANNALS OF SURGERY, vol. lxxii, p. 164, 1920.)



## RANULA

or any other intra-oral structure will not give the key to the correction of this surgical puzzle. If, however, you accept even tentatively, Thompson's cervical sinus hypothesis, you will then be better prepared to attack the cyst either from within the mouth or through a submaxillary incision or both.

### CASE REPORT

A woman thirty-four years of age who complained of a swelling which appeared on the left side of the floor of the mouth about two years ago. The swelling had been lanced repeatedly and "white of egg" material liberated, but for the last few months she has not noticed it. About two months ago the

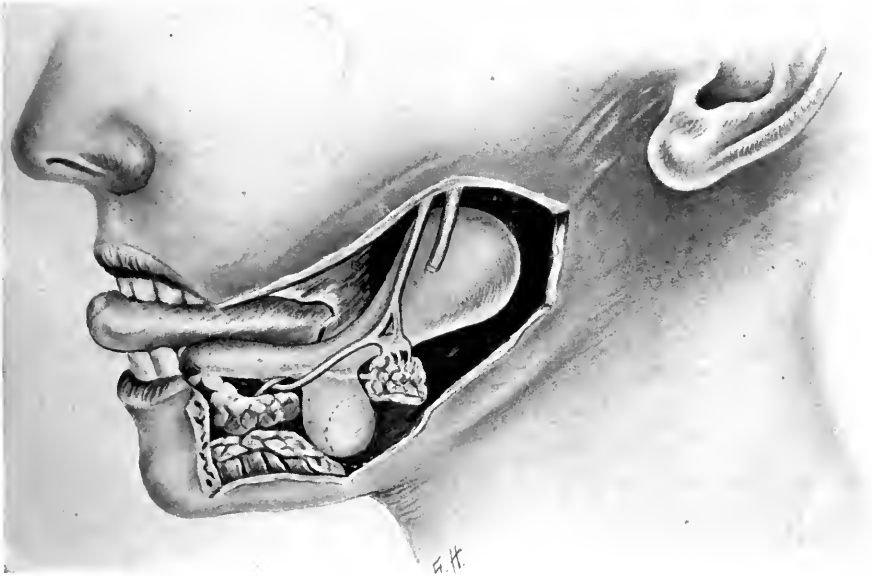


FIG. 2.—Is a semi-diagrammatic drawing of the relations found in the case here reported. It is from sketches made at the time of operation. The greater part of the submaxillary salivary gland lay superficial to the submaxillary extension of the cyst and was removed as a preliminary step in exposing the cyst. It will be noted that there is a constriction at the neck of the submaxillary cyst, bounded posteriorly by the "U" shaped bend of the gland as it turns forward with the first part of Wharton's duct. Normally this "U" bend embraces the posterior free border of the mylohyoid muscle, but here the muscle is pushed well forward by the cyst. Externally the neck is bounded by the submaxillary gland and the lingual nerve, and internally by Wharton's duct. Anteriorly it is sharply constricted above by the lingual nerve which has turned to run under Wharton's duct, and below this by the posterior border of the mylohyoid muscle. It is conceivable that part of the cyst might be pinched off to form the submental cyst sometimes found. The older theory was that submental ranula arose from an extension of the sublingual gland through the mylohyoid muscle. The parafacial part here shown extending upward deep to the lingual nerve did not have the attachment to the base of the skull that was observed in our other cases and it was dissected out intact. In this illustration the internal pterygoid muscle has been omitted. In removing the forward oral prolongation, it was found attached at one point to the upper surface of the sublingual salivary gland in the typical manner that has, I believe, been the chief basis for considering this type of ranula to be a cyst of the sublingual gland.

swelling appeared in the floor of the mouth on the right side, this had also been opened and had reappeared.

*Examination.*—On the left side in the anterior submaxillary region, she had a swelling about 2 cm. across which could be seen but hardly felt except when she swallowed. When she swallowed it became very tense and prominent and could be felt. Bidigital palpation of the floor of the mouth was negative anteriorly. Posteriorly in front of the fauces there was an indistinct fullness, but pressing on this point with one finger and on the tumor in the submaxillary region

with the other, a distinct sense of fluctuation could be obtained. On the right side she had a typical ranula extending from the midline and apparently lost posteriorly in the neighborhood of the first molar tooth.

*Operation.*—Under 2 per cent. novocain block of the lingual and inferior dental nerves of the left side and  $\frac{1}{2}$  per cent. infiltration of the submaxillary skin, an incision was made from just below the angle of the jaw to the middle of the hyoid bone. On drawing the submaxillary gland upward and backward a cyst appeared antero-mesial to the gland. It protruded from the floor of the mouth behind the posterior edge of the mylohyoid muscle which latter was pushed forward of its normal position. The submaxillary gland was removed excepting a little piece at the junction of the duct. The lingual nerve was adherent external (superficial) to the cyst with the branch to the submaxillary ganglion also crossing the cyst. The submaxillary branch was cut and the lingual nerve dissected from the cyst except possibly in one place where it was encapsulated in the wall of the cyst. The cyst was dissected free from the hyoglossus muscle, from the inner surface of the mylohyoid muscle almost to the midline, from the internal pterygoid muscle and from the wall of the pharynx (Fig. 2). A hole was made in the mucosa of the mouth near the first molar tooth. The mouth was opened and the cyst and Wharton's duct brought into the mouth through the opening in the mucosa. The mucosa of the floor was incised anterior to this opening as far forward as the midline and the cyst, Wharton's duct and the sublingual gland were removed in one mass. The wound was lightly packed and the skin approximated with horse hair. Free drainage was used. It was found on completion that the right-sided ranula had emptied itself, and it was not disturbed at this time.

In his original article Doctor Thompson called attention to the impracticability of removing the parafacial extension of the cyst when the latter is closely adherent to the base of the skull and the styloid process. In the Moulin's Treatise on Surgery (note Second American Edition, 1893) in the treatment of ranula, he notes that simple incision and cautery seldom cures, and to avoid the more difficult operation of the excision, recommends a triangular incision and suturing the triangular flap down into the bursa to make a permanent drainage fistula. This same plan, using a large quadrilateral flap from the mucosa of the cheek, can be used to establish permanent drainage from an irremovable part of the parafacial extension of the cyst.

## FACTORS OF SAFETY IN THYROID SURGERY\*

By WILLARD BARTLETT, M.D.

OF ST. LOUIS, MO.

ONE who studies the results of thyroid surgery with a view to lessening mortality and shortening morbidity, may quite well be impressed by the fact that certain fundamental considerations, rather than developments in technic, have pointed out the way toward improved results. Reasoning thus, in our clinic all patients are grouped according to the exceedingly simple classification of Plummer and Wilson under four headings. 1. Exophthalmic Goiter (Hyperplasia). 2. Toxic Thyroid Syndrome (Adenoma). 3. Simple Goiter (Colloid, Adenoma). 4. Malignant Thyroids. One cannot absolutely classify all patients according to the above, or any other rule, since the symptoms do not always conform to those laid down for any one group, but may at times overlap two or more of them. However, one gets farthest by at least attempting a definite selection of the larger group in which the individual seems to belong. Without going deeper into this phase of the subject, which has received extensive consideration at the hands of many authors, we will proceed to the clinical side of it and lay stress on three of its aspects which we have found of utmost value. They are: 1. Classification as to Operative Indications. 2. Multiple Stage Operation. 3. Coöperation of Internist.

The classification of operative indications may vary, and no doubt do with different operators. Doubtless there are other classifications equally as useful as our own, but one is prone to enthuse over the procedure which has served him best. There are five classes into which we divide all patients who are considered fit subjects for surgery. 1. Ligation of superior thyroid vessel group. 2. Unilateral resection of the male subject. 3. Unilateral resection on the female subject. 4. Bilateral resection with wound left open. 5. Bilateral resection with complete wound closure.

As is well known, the superior thyroid ligations are done upon exophthalmic goiter patients as a part of their preparation for the removal of thyroid tissue. Ligations are not performed in the presence of toxic adenoma, because they do no good, and are thought by Charles H. Mayo, to be harmful in many instances.

Unilateral resections on the male (or on the female) subjects differ only in as far as cosmetic considerations go. In the former, we get at half the gland through an oblique incision along the anterior border of the sternomastoid muscle, retract it, spread the ribbon muscles longitudinally, and thus secure a very easy and direct approach to the lobe, and especially to its important upper pole. In the female, we make the customary collar skin

---

\* Read before the Southern Surgical Association, December, 1922.

incision only, then proceed as above outlined for the male subject. A man's collar will cover any sort of skin incision made for the removal of thyroid substance, while a woman must depend upon some sort of chain during the early period of her convalescence. Hence, the separate classification of the two sexes.

Class (4) deals with large non-toxic goiters, irrespective of pathological considerations. After both lobes have been in great part removed, the cavities are packed with rubber and left wide open to allow twenty-four hours shrinkage in the tissues which cover them. During the next twenty-four hours complete cessation of bleeding takes place, so that when the wounds are closed, there is no longer much likelihood of serum or other fluid escaping from the diminished cavity resulting from such treatment.

Class (5) refers to rather small non-toxic goiters, the removal of which is invariably followed by complete closure, because if bleeding be perfectly controlled, there is no reason for leaving a drain behind. It may be stated in passing that we never use a drain as the term is commonly applied. We either pack the wound wide open or close it completely in every instance. Wound closure with us is an exceedingly simple procedure, since we no longer make extensive skin flaps, nor divide ribbon muscles transversely.

In regard to a multiple stage operation or the graduated approach to the complete removal of thyroid tissue, it may be stated that we have subjected one patient at least to as many as seven operative attacks before the ideal had been accomplished. Thus we ligated the right superior thyroid group, five days later we ligated the left superior thyroid group, twelve weeks later we cut flaps and left a pack exposing the right lobe, two days later the right lobe was removed, two days later the skin was closed, seven months later the left lobe was removed, two days later this skin wound was closed.

Of course, we have frequently ligated both superior thyroids at one sitting and removed both lobes at another, hence it will be seen that the graduated approach with us has meant two, three, four, or even more operative stages up to the number of seven, which is admitted to be the practicable limit. It will be stated, however, that in this last instance, we seemed at each attempt to go as far as the patient's endurance would permit.

The coöperation of the internist is considered most essential. With us, this matter is carried to the extent of allowing him the last word in deciding, not only what patients shall be operated upon, but he goes so far as to select the date of operation. We believe in this way, and in this way alone, that we can successfully do justice to the many considerations which in the past have led to an unwise choice of time for operation. We believe that an internist, who is especially trained for this work, will be guided in his choice of a subject for operation by five major fields for study, in addition to a large number of minor ones, namely The: 1. Myocardium. 2. Kidney function. 3. Metabolic rate (relative). 4. The patient's weight (relative). 5. The patient's self-control. These five considerations are so well known and so

self-evident that most of them need hardly more than passing mention here, still, one may with propriety, add that the myocardium seems to us to play the leading rôle in the selection of a toxic surgical patient. The kidney function is determined by the ordinary methods of urinalysis, coupled with P. S. P. and N. P. N. in the ordinary run of cases. The metabolic rate is not a determining factor, but is merely taken into consideration with all of the clinical elements which go to make up the resumé. The patient's weight is very important. We feel that it is always a good sign when a patient is gaining weight, provided only that this be not due to an accumulation of fluid in the tissues. The patient's self-control is also of vast importance, especially since most of the operations on toxic patients are done without a deep general anæsthesia. The post-operative self-control of the patient should insure the minimum of restlessness as the resources of a toxic heart are thus only to be conserved. Here the matter of the patient's self-control becomes of vital importance in many instances.

Very little has been written, purposely, about the operative technic, since, as was stated in the beginning, we believe that our improved results have, in recent years, been largely due to a rigid observation of the various classifications which have been briefly stated. Still, there are technical considerations of so much value that it would perhaps be unwise to conclude without at least according them whatever prominence they may seem to deserve. They are: 1. Anæsthesia (three components). 2. Where operate? 3. Open or closed wound.

We are in our clinic strictly inclined toward local anæsthesia in our operations upon all types of goiters. This is said without minimizing in any way the value of general anæsthesia in certain uncontrollable patients. We believe, even when we stress novocain infiltration, that still, a local anæsthesia is made up of three components of which the infiltration is only one, the other two being some sort of a drug preparation (morphine, heroin, veronal, etc.) and the nitrous oxide oxygen combination, which Crile uses as a mask for infiltration. We do not employ this last as a routine, but never refuse it to a sufferer who asks for it and certainly do not spare it when we feel that we are safeguarding the patient's well being.

As to where to operate, it seems to us that the operating room offers better light and more conveniences than can be obtained elsewhere in the hospital for those individuals whose nervous systems are not unduly influenced by these unusual surroundings. This class can be greatly enlarged by the free use of preliminary drugs, but we often do a ligation in a patient's bed, and indeed during our hot summer months in St. Louis we very much like to do the thyroidectomy, as well as the ligation, on screened, well-lighted, breezy open porches. It is for the reason that a toxic patient with a high metabolic rate will remain surprisingly quiet if she gets all of the oxygen she needs, as is rarely the case indoors, especially in a small crowded room.

Whether to leave open or to close the wound, has been discussed in pass-

ing, but we will refer to it again in connection with the highly toxic goiter. It seems to us that every toxic patient should have the thyroidectomy wound left open in order that there may be no possibility of the damming back of any of the fluids during the course of the operation. This was proven in our earlier work by the removal of sutures, resulting in the rapid clearing up of a dangerous post-operative thyrotoxic condition, as serum escaped from what had been a closed wound. The operation is in addition, considerably shortened by leaving the wound open, while the patient is only slightly disturbed twenty-four hours later when rubber packs are slipped out and three or four skin clips applied.

One may add in closing that the relative space here accorded technical considerations in comparison with that accorded the reasoning of a more fundamental nature, expresses pretty well our opinion of the relative values of these two components, which go together to make for better results in the surgical treatment of thyroid disease.

## PATHOLOGICAL FRACTURE OF THE NECK OF THE FEMUR, DUE TO THYROID METASTASIS

BY ISADORE ZADEK, M.D.

OF NEW YORK, N. Y.

*Case Report.*—Patient a man, aged fifty-six, family history, negative, past history, negative. In January, 1920, while running to catch a street car, the patient slipped on the ice and fell, striking his left hip on the pavement. He was picked up and carried off the street. Thirty minutes later he got up and went to work, although he limped and had pain in the hip. He continued working and on the third day, as pain and lameness continued, he called in the family doctor who said there was nothing wrong with him.

Two weeks later he called in another doctor who said he had a bruise only. A third doctor said he had a "cold in the nerves." For five weeks he received baking and massage three times a week at the dispensary of the Hospital for Joint Diseases. This treatment relieved him temporarily. In June, 1920, he went to Bellevue Hospital where an X-ray showed a rarefied area at the base of the neck of the femur. As the limb was wasting, it was thought a malignant tumor might be present. He was operated upon. An incision was made on the lateral aspect of the hip and a piece of tissue was removed. No tumor was found. Nothing else was done and in six weeks he went home. He got a special shoe which he has worn since. During the winter of 1921, he received baking and massage for six weeks at Beth Israel Hospital.

On examination April 2, 1921, by Dr. Royal Whitman the following note was made. "Walks with crutches—left limb practically helpless. Lifts it with hand. Shoe has one and a half inch elevation. Has considerable pain, especially at night. Unable to lie on affected side. Distance from the anterior superior spine to the internal malleolus on the right  $33\frac{3}{4}$  inches. Distance from the anterior superior spine to the internal malleolus on the left 32 inches. There is pain on motion. Marked limitation on attempted abduction and rotation. Presents large inguinal hernia on left side. Tumor size of testicle on right side. X-ray shows complete absorption head of femur and atrophy of neck. Base of neck appears to be in contact with head. Reconstruction operation."

Operation, April 4, 1921, by Doctor Zadek. Usual incision was made in the line of the thigh midway between the anterior superior spine of the ilium and the greater trochanter. Fascia lata was split in the line of the skin incision and exposure made between the tensor fascia femoris and the vastus externus. There were numerous moderately enlarged veins running in the direction of the external circumflex which were ligated. Capsule was opened in the direction of the neck. It was markedly thickened. Further exposure showed that the actual conditions were not as one would have expected from the X-rays. The chief line of fracture with displacement was intertrochanteric. Almost all of the greater trochanter was adherent to the head and neck fragment. Only the outer shell of the greater trochanter was connected with the shaft fragment. At the site of fracture there was a large cavity extending down the shaft for about 2 inches and extending probably 1 inch into the base of the neck and into the greater trochanter, the total size of which was about that of a large egg. The fracture was comminuted and one small fragment was removed. The greater trochanter was broken from the base of the neck in addition, but was not displaced and the lesser trochanter was likewise broken but not displaced. The bone cavity was

filled with what was, grossly, reddish, velvety, granulation tissue, which was quite friable. Underneath this granulation tissue the bone was apparently solid. The edges of the fragments were quite irregular and serrated. This tissue resembling granulation tissue was thoroughly removed with a curette and the shaft fragment forced upward into the cavity in the upper fragment. The muscles and fascia were closed with interrupted and continuous catgut sutures and the skin closed with continuous catgut. Plaster-of-Paris spica was applied extending from the nipple line to the toes with the hip in 20 degrees abduction, moderate outward rotation and full extension. Some of the tissue was saved for microscopical examination. It is interesting to note that there has been absolutely no attempt at repair of the fracture. The tumor does not pulsate.

"The piece of tissue sent to the pathological laboratory was reported by Dr. F. M. Jefferies as aberrant thyroid. Thyroid-adenoma." The thyroid acini contain colloid.

The wound subsequently became infected and on April 14, 1921, the original incision was closed with silkworm gut and another incision made posteriorly for better drainage. When the true nature of this tumor was known an attempt was made to discover the possible existence of other such tumors in the body. X-rays of all of the bones of the body including the skull, spine and pelvis were taken and they were all negative. X-rays of the lungs were likewise negative. As far as one can determine by physical examination patient's thyroid gland is normal.

Examination of the urine was negative save for a faint trace of albumen. There were no Bence-Jones bodies found on several examinations. X-rays taken after operation showed the alignment of the fragments good.

Patient was discharged from the hospital July 25, 1921. At this time patient could voluntarily flex the hip to 125 degrees. There was apparently good union at the site of fracture, the head of the femur moving with the shaft fragment. Patient had voluntary abduction of 15 degrees at the hip. Measurements at this time were: Distance from the anterior superior spine to the internal malleolus on the right  $33\frac{1}{2}$  inches: Distance from the anterior superior spine to the internal malleolus on the left  $30\frac{3}{4}$  inches. Patient subsequently developed an abscess of the left thigh and was admitted to Beth Israel Hospital where the thigh was incised and drained. He was admitted December 25, 1921, and discharged February 24, 1922.

Patient continued to have fairly marked pain in the left lower extremity and developed other local abscesses. He was admitted to Montefiore Home, March 22, 1922. Dr. E. D. Oppenheimer, who examined the patient after admission to Montefiore Home informed me that he thought patient had bony union at the hip. A plaster case was applied May 26, 1922, in the form of a short spica, which had to be removed on account of patient's objection. September 23, 1922, patient developed a violent hemorrhage from the hip which left him almost exsanguinated before it could be checked by packing. September 27, 1922, patient developed high fever and physical signs of pneumonia from which he died October 4, 1922. Autopsy was not obtained.

*Conclusions.*—It seems likely that this occurrence of hemorrhage spontaneously was induced by a recurrence of the tumor, which seems also likely from the X-ray appearance of the involved region as shown by the changes that have occurred between the times that the X-rays Nos. 3 and 4 were taken. The persistence of pain is likewise suggestive of malignancy. Also it would seem, notwithstanding the gross and microscopic appearances of



this tumor, neither of which suggested malignancy, that the tumor was nevertheless malignant.

Ewing states that "in a few instances tumors of thyroid tissue have developed under circumstances which suggested an origin from aberrant cells from the normal thyroid." He reports that Riedel removed a tumor of the inferior maxilla composed of normal thyroid tissue which recurred locally after ten years. During this period of observation the thyroid gland is said to have remained normal. In explanation of these cases it seems necessary to assume an origin either from aberrant thyroid tissue or from the normal thyroid. Comparing the structure of primary and secondary thyroid tumors, Jaeger finds that: (1) Both may be benign; (2) primary tumor malignant—secondary tumor benign; (3) primary tumor may be benign and the secondary tumor malignant; (4) both tumors may be malignant.

Pulsating bone tumors have in several instances been identified as



FIG. 1.—X-ray taken June, 1920, showing rarefying osteitis at the base of the neck of the femur. Before fracture occurred.

metastatic thyroid growths. Swelling of such a tumor was interpreted by V. Eiselsberg as a menstrual phenomenon. Solitary bone metastases have been observed by V. Eiselsberg and others. That many metastatic thyroid tumors functionate is indicated by the presence of colloid.

J. Christopher O'Day says, "Insofar as we were able to determine, it would seem that an infarct of normal or rather malignant free thyroid cells is unable to proliferate outside of bony tissue while those bearing the elements of malignancy are capable of development within any tissue of the body and often with such rapidity as to have the resulting growth mistaken for the primary one." He quotes K. Kolb: "All sarcoma-like tumors in the bones,

especially in the skull, should suggest the possibility of metastases of thyroid tissue."

J. Phillip Kanoky gives an excellent bibliography of the subject under consideration and then reports a case of his own. The patient was a woman forty years old, who eight years previously had an intrathoracic tumor of the right lobe of the thyroid removed. Five years after this operation a tumor the size of a hazelnut appeared in the left parietal region. At this time the patient was operated upon but the tumor was not removed on account of the very severe hemorrhage encountered. A preliminary ligation of the

common carotid was decided upon. The patient stood this operation well but died suddenly thirty-six hours after the operation—apparently from embolus. Post-mortem removal of the tumor showed it to be thyroid. There was absolutely no evidence of malignancy.

G. E. Beilby presents an excellent classification of various types of thyroid



FIG. 2.—X-ray taken March, 1921, showing fracture at the base of the neck of the femur. Before operation.

disease. Under one group he places aberrant or metastatic thyroid tumors which are histologically benign but clinically malignant. He records the history of a man sixty-five years of age who was operated upon for a tumor involving the right antrum of Highmore. The tumor was so extensive that it could not be completely removed. It proved to be thyroid. He states: "There are now (1907) in the literature records of about twenty cases of tumors apparently metastases from the thyroid which were histologically benign. As in a number of these instances there has been no apparent thyroid lesion, these cases have been considered as metastases from normal thyroid tissue." Where a thyroid lesion has been observed it has been that of simple hypertrophy or adenoma and the metastatic tumor has had a similar histologic structure. These metastases, which may be single or multiple, have occurred most frequently in bone and have often been removed under the

supposition that they were primary growths. Aside from the fact that these tumors are probably of metastatic origin, they present as a rule no other indication of malignancy. Frequently, however, they have been known to recur after removal and a number of cases have thus resulted fatally. Therefore the important question arises: Are not these tumors malignant and should they not always be considered as such by the surgeon? In the case reported by Oderfeld and Steinhaus the first tumor observed was in the frontal bone. This was removed and histologically found to have the structure of normal thyroid. There was no evident recurrence after six months. After

about a year there was recurrence and also other similar tumors made their appearance—one in the temporal region and one at the sternoclavicular articulation. Clinically these tumors were considered to be malignant. At the request of the patient the one in the temporal region was removed. The patient died a few weeks later. Just before death a thickening of the under



FIG. 3.—X-ray taken April, 1921, showing fracture at the base of the neck of the femur. After operation.

half of the right lobe of the thyroid was noted. A complete autopsy was not permitted, but all visible tumors were removed, together with the thyroid gland. Within the substance of the right lobe of the thyroid was found a small nodular thickening two centimetres in diameter. The remainder of the thyroid appeared normal. The tissues were all carefully sectioned and examined, the authors expecting to find carcinomatous degeneration, but the structure throughout the tumor of the thyroid and the other isolated tumors of the head and neck were uniformly the same and, as they observe, had the exact structure of normal thyroid tissue. They regard the small thyroid nodule as the primary tumor and the tumors of the head and neck as metastases.

G. Blumer states: "The thyroid tumors which give rise to bone metastases present some very marked peculiarities. While some of them are very evidently malignant, judged from their clinical manifestations alone, others show none of the ordinary evidences of malignancy. An analysis of sixty cases from the literature shows that two-thirds of the thyroid metastases occur in women and 90 per cent. of the cases between the ages of thirty and seventy. No obvious clinical involvement of the thyroid is present in at least 25 per cent. of the cases. Clinically two-thirds of the metastases are of the solitary



FIG. 4.—X-ray taken March 24, 1922, showing considerably greater involvement about the neck of the femur than was present when previous X-ray was made. This suggests recurrence of the tumor rather than osteomyelitis. It is also apparent that since the last X-ray was taken, further depression of the neck has occurred.

type and even at post-mortem multiple metastases are the exception. So far as distribution of the thyroid metastases is concerned: 38 per cent. of them occur in the bones of the cranium or face; 16 per cent. in the vertebræ; 10 per cent. in the femur; 9 per cent. in the pelvic bones; 7 per cent. in the sternum, and 5 per cent. in the humerus.

"Of the facial metastases

seven out of nine were in the lower jaw. Spontaneous fractures occur in 9 per cent. of the cases. The slowness of growth of the bone metastases is in some cases most remarkable and makes them unusually favorable for surgical removal. In one instance a tumor of the malar bone had been present for thirteen years; in another instance a tumor of the sternum had been present for seventeen years, and in still another case a tumor of the lower jaw had been present for ten years. Growth may be greatly accentuated by trauma or the metastases may first appear after trauma. Compared with some other bone metastases, those from the thyroid gland frequently show a comparatively low grade of malignancy. As a rule the thyroid bone metastases are exceedingly vascular and some of them

pulsate. For this reason they have occasionally been mistaken for aneurisms, particularly those involving the sternum, pelvis, and skull."

F. X. Dercum records the history and findings in a woman aged fifty-six years, who had a goiter for some years—just how many isn't stated. The goiter was removed August 15, 1899. Convalescence was uneventful. Goiter was of the simple type. One year after operation patient developed pain in left upper extremity. Later pains became general and wasting of muscles ensued—examination showed signs of transverse myelitis. There was a

tumor the size of a guinea egg at the left sterno-clavicular joint—it was semisolid to the touch. The spine showed two prominences—one in the upper thoracic region and another in the lower lumbar region. The patient died November 22nd. Autopsy showed a tumor mass pressing on the cord at the level of the fourth and

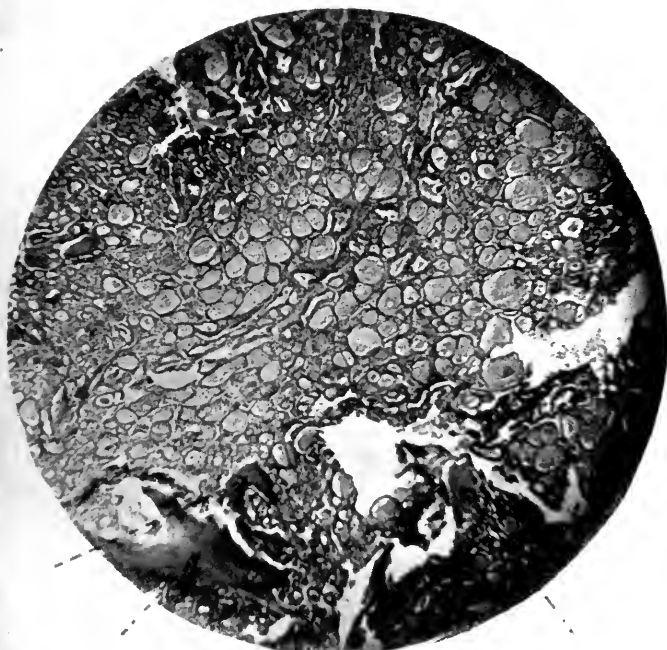


FIG. 5.—Photomicrograph (low power) of tumor tissue removed at time of operation. Dotted lines point to bone spicules in midst of thyroid tissue.

fifth cervical vertebræ and another at the second lumbar. There were tumors involving ribs as well as the sterno-clavicular joint. Only the upper spinal tumor was examined microscopically. It showed thyroid gland.

From observation made in recent years it is evident that an ordinary goiter which has existed for a long time, which has never given rise to any symptoms suggesting malignancy, may suddenly become widely diffused. These secondary tumors may be removed without any attention being directed to the primary tumor of the thyroid. Connheim, Lucke and Miller have described such cases. They were collected by Hansell in 1899. Patel reported eighteen cases of thyroid metastases. These cases were practically all associated with thyroid enlargement. Metastases were found in bones,

particularly the short and flat bones. Wolfer maintains that if a metastatic growth not only increases in size, but also takes on a destructive action upon the bone, the primary tumors cannot be considered benign even when clinical, anatomical or even histological investigations have failed to establish their malignant character.

Further it follows that such metastatic growths exert in the economy a function similar or identical with that of thyroid tissue in its normal position.

A. E. Hertzler states that: "There has been a controversy as to the possibility of a normal gland producing metastases. It has occurred in glands with slight malignancy and those cases in which metastasis has occurred from supposedly normal glands probably belong to this class. Metastasis may occur so early that the secondary tumor is regarded as primary. This indicates the importance of suspecting the thyroid whenever obscure epithelial tumors occur in regions where epithelium does not normally occur."

A. J. Ochsner and R. L. Thompson, speaking of carcinoma of the thyroid, say: "At times the structure of these malignant growths bears a close resemblance to actively proliferating goiters or even to normal thyroid gland, so that histological differentiation as to malignancy is extremely difficult or at times impossible, the metastatic nodules in the lungs, liver, bone, etc., for instance, corresponding almost identically with normal thyroid gland. Bone metastases are especially to be noted in connection with those malignant thyroid tumors which apparently find a most suitable opportunity for growth in bone-marrow. This favorable influence of bone-marrow on thyroid proliferation is borne out by the fact that such a situation is best adapted to successful thyroid transplantation."

H. G. Wells makes the statement that: "Metastasis of normal thyroid tissue and of benign neoplasms has been reported in a number of instances. This apparent exception to the rules of tumor and tissue growth would seem to be best explained in the light of the latest studies as due entirely to misinterpretation of histological pictures or to inaccurately studied cases."

An example is the report of Oderfeld and Steinhilber published as recently as 1901. This report concerned an instance in which a growth had developed in the left frontal bone, having the structure of normal thyroid gland and it did not recur after removal. In the absence of any evidence of disease in the thyroid itself this growth was believed by the writers to be the result of metastasis of normal thyroid tissue, which had proliferated in its new location as does a thyroid graft. A similar case had been reported by Riedel. In less than two years the authors named above were obliged to report an entirely different explanation. The patient had died in the meantime with multiple metastases, all of which had a structure that resembled normal thyroid. The thyroid itself showed no growth except a small encapsulated nodule which also was of the structure of normal thyroid. They were obliged to conclude that, after all, their case was one of carcinoma of the thyroid with metastases,

remarkable chiefly for the resemblance of the structure of the tumor to that of the gland. A study of many cases of thyroid carcinoma shows that the metastases have a decided tendency, which is particularly true of adenocarcinoma, to reproduce the structure of normal thyroid gland follicles. It is highly probable that the above-mentioned facts are sufficient to explain the supposed instance of transportation of normal gland tissue or adenomas and that it is safe to assume that when any structure of the thyroid produces metastases, it is to be considered *prima facie* evidence of the malignancy of that structure.

# INVOLVEMENT OF THE LYMPH GLANDS IN CANCER OF THE CÆCUM

By WINCHELL McK. CRAIG, M.D.

FELLOW IN SURGERY, THE MAYO FOUNDATION

AND

WM. CARPENTER MACCARTY, M.D.

OF ROCHESTER, MINN.

FROM THE SECTION ON SURGICAL PATHOLOGY, MAYO CLINIC

IT is generally accepted that involvement of the lymph glands is a guide to the extensiveness of the operation as well as an aid in prognosis. The gastro-intestinal tract, except the cæcum and small intestine, from the stomach to the rectum has been studied in the Mayo Clinic from the standpoint of involvement of the lymph glands. In 1912, MacCarty and Blackford studied the lymph glands of the stomach, in 1920, McVay studied the rectum, and in 1921, Hayes continued the investigation in cases of cancer of the large bowel, except the small intestine and cæcum.

In considering the lymphatic drainage of the cæcum with regard to involvement in cancer, Clogg has shown that dissemination is along certain anatomic lines. He uses the classification of Jamieson and Dobson, which has also been used in this study (Fig. 1). The course of the lymphatic vessels of the cæcum is closely associated with that of the ileocolic blood-vessels. The ileocolic artery is surrounded from its origin to its division by a chain of lymphatic glands varying in number from ten to twenty and in size from about 1 mm. to 3 cm. The chain is often continuous without interspace with the gland around the superior mesenteric artery. At the point where the ileocolic artery gives off its terminal branches the chain of glands becomes broken into several groups which are associated with the branches of the artery. These groups are constant in number, though not in the number of their constituent members, and are sufficiently distinct from each other to be described in five groups. These groups form a basis for the study of the involvement of the lymph glands in cancer of the cæcum: Group 1, anterior ileocolic, Group 2, posterior ileocolic, Group 3, appendicular, Group 4, ileal, and Group 5, right colic.

The lymph vessels which drain the cæcum are simple in their arrangement, conforming to the plan of the glands (Fig. 2). However, there may be vessels which do not drain into the five groups of glands, but drain directly into those around the ileocolic artery above, and these must be kept in mind in exploring the abdomen for possible involvement.

Cancer of the cæcum originates in the glands of Lieberkühn. Around these glands are numerous lymphatics which form a thick network below. This is in combination with a second coarser network in the submucosa. The



FIG. 1.—Anterior surface of cæcum. Anatomic distribution of normal lymph glands. (Jamieson and Dobson.)

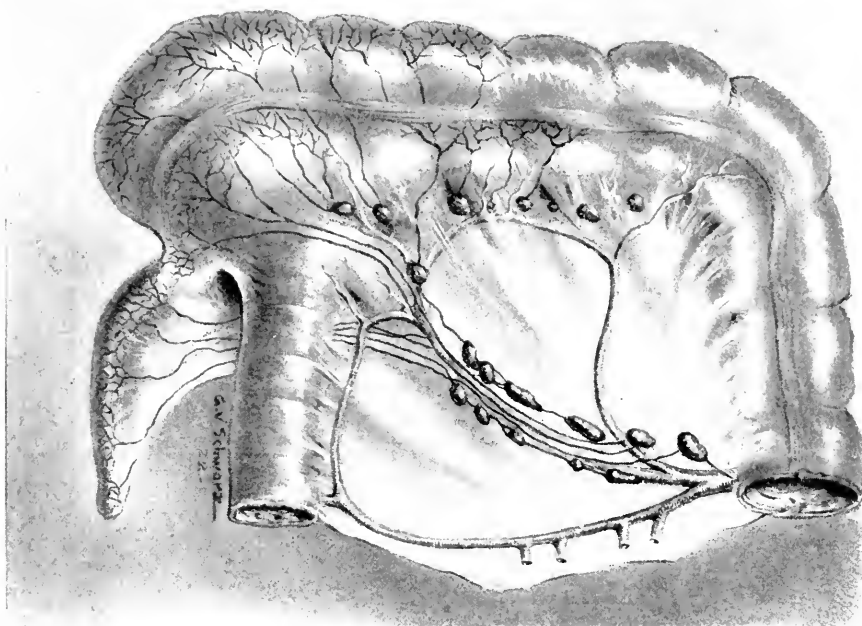
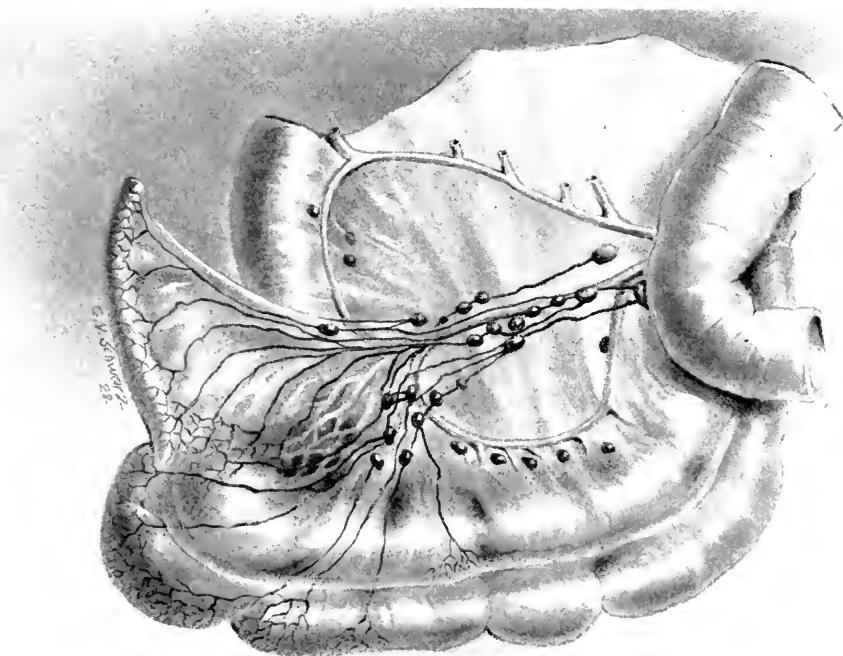


FIG. 2.—Posterior surface of cæcum. Anatomic distribution of normal lymph glands. (Jamieson and Dobson.)



efferent vessels pass through the muscularis, collecting the fluid from numerous lymphatics in the muscle and form a lymphatic plexus between the layers of the mesentery (Fig. 3).

There has been some dispute concerning the involvement of the ileo-

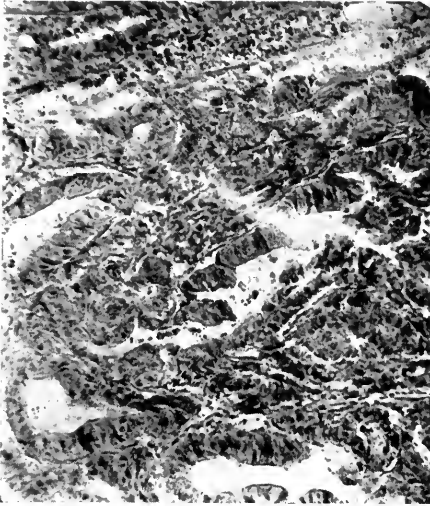


FIG. 3.—(A263481). Arrangement of cells in carcinoma of the cæcum.

cæcal valve in cancer of the cæcum. In the literature, however, the evidence seems to show that it is involved in the greater number of cases. Mummery says that "The commonest situation of growth in carcinoma of the ileocæcal angle is at the ileocæcal valve." Ewald, in his series of sixty-four cases, found 50 per cent. involving the valve. In our series 64 per cent. had involved the valve.

One hundred preserved specimens of cancer of the cæcum which had been removed at operation in the Mayo Clinic formed the basis of this study. The gross specimens, the size, form, location, extent, and character of the growth and the surrounding tissues

were first examined and records made. The lymph glands were then dissected out, particular attention being paid to the position and the anatomic distribution of the normal glands. They were all "teased out" by reducing the tissue into thin layers and transmitting the light through, in order to get the smallest as well as the largest units. As they were removed they were placed in phials, depending on their location, and their numbers and position were recorded on the charts.

The glands and sections from the original growth were studied microscopically, and the growths classified into the five groups mentioned (Fig. 4). The histories were reviewed for the purpose of checking the clinical and the pathologic diagnosis.

The cases were divided into three groups: Group 1, cases without glandular involvement; Group 2, cases with glandular involvement; and Groups 3a and b cases of colloid carcinoma, selected from Groups 1 and 2.

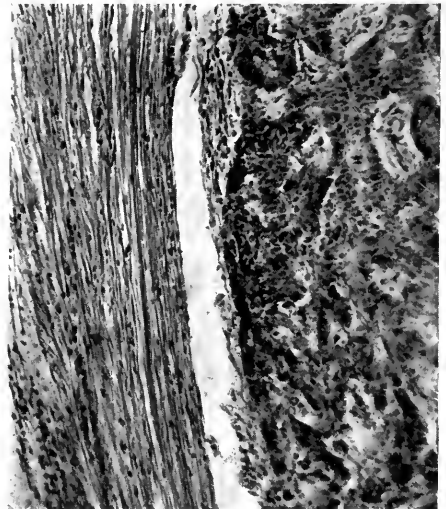


FIG. 4.—(A217584). Lymph glands showing thick capsule and carcinoma cells.



FIG. 5.—(A25392). Solid carcinoma filling lumen of the cæcum. Appendix not involved. No metastasis to regional lymph glands.



FIG. 6.—(A98833). Annular carcinoma of the cæcum which involved ileocecal valve but did not metastasize to regional lymph glands.

GROUP 1.—*Cancer without metastatic involvement of the regional lymph glands.*—There were sixty-eight patients (68 per cent.) in this group. Twenty-three were females and forty-five were males; the average age was forty-nine years. The average number of glands in each specimen was 8.84; the total number of glands was 629. Several specimens were found with few or no glands, but as a rule the glands were numerous and large, ranging from the almost microscopical 1 mm. to that of 3 cm. (Table I.) (Fig. 5). The outstanding feature of the "inflammatory" glands was the predominance



FIG. 7.—(A184960). Carcinoma of the posterior wall with involved glands. This specimen had thirteen glands, of which only six showed metastatic involvement.

of the posterior ileocolics, both in size and number. In only two cases were the appendicular glands enlarged, and this was probably due to appendicitis. The ileocaecal valve was involved in thirty-nine cases (50 per cent.) and in twenty cases (29 per cent.) the growth was annular or cylindrical, involving all the walls (Fig. 6).

GROUP 2.—*Cancer with metastatic involvement of the regional lymph glands.*—There were thirty-two patients in this group; eight were females and twenty-four males; the average age was 49.2 years. The average number of glands in each specimen was 12.3; the average number involved by metastasis in each specimen was 3.59, and the total number

of glands was 396. (Table II) (Fig. 7). Again the predominance of the posterior ileocolic glands was manifested. And further, in the thirty-two cases of involvement of the lymph glands, the posterior ileocolics were involved in twenty-nine. Nine appendicular glands were found, but none of them were the seat of metastasis. The ileocaecal valve was involved in twenty-five of the thirty-two cases (78 per cent.) and in all cases the growth was annular or cylindrical, involving the entire wall.

Primarily, all cancers of the cecum are of the adenocarcinomatous type and the colloid variety has been regarded as a degenerative process (Fig. 8). Parham, in a recent paper, has thrown new light on this phase of the subject. After an exhaustive study of colloid cancer he concluded that a functional

# LYMPH GLANDS IN CANCER OF THE CÆCUM

TABLE I

Group I. Carcinoma of the Cæcum Without Glandular Involvement.

Case	Sex, Age	Location	Glands	Case	Sex, Age	Location	Glands
A208874	M-62	Anterior ileocolic	4	A203094	M-59	Anterior ileocolic	4
		Posterior ileocolic	5	A204856	F-63	Anterior ileocolic	2
A156932	M-62	Anterior ileocolic	6			Posterior ileocolic	9
		Posterior ileocolic	14	A182683	F-47	Anterior ileocolic	6
		Appendicular	9	A169495	M-48	Anterior ileocolic	3
A226072	F-42	Anterior ileocolic	5			Posterior ileocolic	8
A112389	F-63	Anterior ileocolic	5	A125209	M-31	Anterior ileocolic	5
A231897	M-59	Anterior ileocolic	6			Posterior ileocolic	9
A219508	M-70	Anterior ileocolic	6	A76186	F-58	Anterior ileocolic	2
A261071	M-65	Anterior ileocolic	7			Posterior ileocolic	9
		Posterior ileocolic	5	A273156	F-58	Anterior ileocolic	3
A254414	F-63	Anterior ileocolic	4			Posterior ileocolic	9
		Right colic	2	A261786	M-43	Anterior ileocolic	5
A263481	M-46	Anterior ileocolic	2			Posterior ileocolic	3
		Posterior ileocolic	16	A224716	M-59	Anterior ileocolic	2
		Right colic	3			Posterior ileocolic	12
A274871	M-58	Anterior ileocolic	2	A290336	M-31	Anterior ileocolic	4
		Posterior ileocolic	7	A307312	M-39	Anterior ileocolic	2
A336867	M-56	Anterior ileocolic	4			Posterior ileocolic	10
		Ileal	2			Ileal	2
A40635	M-40	Anterior ileocolic	5	A48660	M-54	Anterior ileocolic	4
		Posterior ileocolic	10			Posterior ileocolic	10
A22895	M-48	Anterior ileocolic	4	A18536	M-49	Anterior ileocolic	5
		Posterior ileocolic	9			Posterior ileocolic	9
A57231	F-28	None					
A295762	M-41	Posterior ileocolic	16	A184954	F-39	Posterior ileocolic	16
A190106	F-38	Posterior ileocolic	12	A183363	M-56	Posterior ileocolic	9
A114808	M-66	Posterior ileocolic	8	A203555	M-73	Posterior ileocolic	9
		Ileal	5	A107964	M-51	Posterior ileocolic	5
A134338	M-65	Posterior ileocolic	6	A127339	M-36	Posterior ileocolic	12
A99833	F-46	Posterior ileocolic	2	A68450	F-47	Posterior ileocolic	7
		Ileal	4	A70127	F-40	Posterior ileocolic	8
A64593	M-38	Posterior ileocolic	8	A63548	M-58	Posterior ileocolic	6
A221979	M-49	Posterior ileocolic	18	A364875	F-44	Posterior ileocolic	8
A257848	M-44	Posterior ileocolic	12	A254633	M-57	Posterior ileocolic	2
		Ileal	3	A282203	F-38	Posterior ileocolic	14
A351494	M-57	Posterior ileocolic	8	A304737	M-31	Posterior ileocolic	12
A339017	F-49	Posterior ileocolic	8	A335834	M-49	Posterior ileocolic	13
A307746	M-64	Posterior ileocolic	5	A338349	F-34	Posterior ileocolic	2
A324824	F-58	Posterior ileocolic	8	A347708	M-65	Posterior ileocolic	6
A313898	M-66	Posterior ileocolic	4	A86405	M-38	Posterior ileocolic	8
A92504	F-43	Posterior ileocolic	5	A58736	F-42	Posterior ileocolic	12
A68010	M-51	Posterior ileocolic	10	A62812	F-63	Posterior ileocolic	4
A57330	F-49	Posterior ileocolic	8	A76173	M-55	Posterior ileocolic	6
A48922	M-71	Posterior ileocolic	9	A25637	M-48	Posterior ileocolic	4
A4464	F-68	Posterior ileocolic	6	A35049	M-40	Posterior ileocolic	2
		Ileal	5	A11977	M-46	Posterior ileocolic	9
A25392	M-47	Posterior ileocolic	9				
A303742	M-37	Ileal	3				

TABLE I.—*Continued.*  
*Summary of Group 1*

Patients.....	68 (68 per cent.)
Females .....	23
Males.....	45
Average age.....	49 years
Posterior ileocolic glands .....	484
Anterior ileocolic glands.....	107
Appendicular glands.....	5
Ileal glands.....	24
Right colic glands .....	5
Total number of glands .....	629
Average number of glands in specimen.....	8.84

differentiation of the cancer cells is demonstrated by the production of mucus in quantities which show that the function is uncontrolled, and that colloid cancer usually grows slowly and metastasizes late. This statement he modified by the division of colloid cancer into two groups based on the microscopic

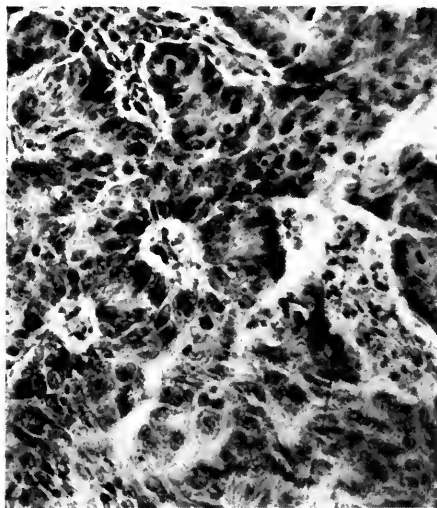


FIG. 8.—(A50540). Adenocarcinoma forming in a lymph gland. Mitotic figures present.

picture, those showing the “signet ring” types of cellular morphology being more malignant than the glandular type with columnar cells (Fig. 9.) In discussing the glandular involvement he says that local glands are commonly affected, but distant metastasis is slow. Recurrence is often localized to the site of origin, thus showing the difficulty of local eradication (Fig. 10). Twenty-two per cent. of Parham’s cases of cancer of the cæcum were of the colloid type; he says “As compared to carcinoma of the cæcum in general, colloid carcinoma of the cæcum has the greater longevity.”

GROUP 3A.—*Colloid cancer without metastatic involvement of the regional lymph glands.*—There were eight patients in this group, three females and five males; the average age was forty-eight years. The total number of glands was forty-eight, and the average number in each specimen was 7.2.

GROUP 3B.—*Colloid cancer with metastatic involvement of the regional lymph glands.*—There were twelve patients in this group, two females and ten males; the average age was 49.3 years. The total number of glands was 144. Fifty-one glands were involved; ninety-three were inflammatory. The average number of glands in each specimen was twelve (Figs. 11 and 12).

#### SUMMARY

One hundred pathologic specimens and 1,033 associated lymph glands were examined.

# LYMPH GLANDS IN CANCER OF THE CÆCUM

TABLE II.

*Group 2. Carcinoma of the Cæcum With and Without Glandular Involvement.*

Case	Sex, Age	With	Glands	Without	Glands
A144469	M-50	Posterior ileocolic	1	Anterior ileocolic Posterior ileocolic	5 8
A217584	M-53	Posterior ileocolic	3	Anterior ileocolic Posterior ileocolic	6 11
A299507	M-60	Anterior ileocolic	1	Posterior ileocolic	10
A299107	F-66	Ileal	2	Ileal	2
A294841	M-38	Posterior ileocolic	3	Ileal	3
A338189	F-59	Posterior ileocolic	2	Posterior ileocolic	6
A321512	M-68	Posterior ileocolic	2	Posterior ileocolic	6
A8563	M-52	Posterior ileocolic	3	Posterior ileocolic	3
A28431	F-58	Posterior ileocolic	1	Posterior ileocolic	8
A11977	M-48	Posterior ileocolic	1	Posterior ileocolic Anterior ileocolic	7 10
A17527	M-52	Posterior ileocolic	2	Posterior ileocolic Anterior ileocolic Appendicular Ileal	8 5 9 4
A165146	M-53	Posterior ileocolic	2	Posterior ileocolic	9
A180796	M-42	Posterior ileocolic	2	Posterior ileocolic	8
A126319	M-54	Posterior ileocolic	2	Posterior ileocolic	4
A102581	M-49	Posterior ileocolic	1	Posterior ileocolic	9
A137095	M-47	Anterior ileocolic	2	Posterior ileocolic	6
A146060	M-68	Posterior ileocolic	6	Anterior ileocolic Posterior ileocolic	5 2
A250540	M-70	Posterior ileocolic Ileal	2 2	Anterior ileocolic	10
A31000	F-59	Anterior ileocolic Posterior ileocolic	5 1	Posterior ileocolic	5
A101909	F-60	Posterior ileocolic	6	Anterior ileocolic Posterior ileocolic	3 5
A213118	F-30	Ileal	4	Ileal	4
A207819	M-47	Posterior ileocolic	4	Posterior ileocolic	3
A207387	M-54	Posterior ileocolic Anterior ileocolic	4 3	Posterior ileocolic Anterior ileocolic	9 1
A178416	M-20	Posterior ileocolic Anterior ileocolic	2 6	Posterior ileocolic	7
A159065	M-67	Posterior ileocolic Anterior ileocolic	3 2	Posterior ileocolic Anterior ileocolic	2 12
A40635	M-40	Posterior ileocolic Anterior ileocolic	2 5	Posterior ileocolic	6
A86068	M-48	Posterior ileocolic	7	Posterior ileocolic Anterior ileocolic	3 4
A248256	M-53	Posterior ileocolic Anterior ileocolic	4 2	Posterior ileocolic Ileal	13 3
A210885	F-58	Anterior ileocolic	4	Posterior ileocolic	19
A217183	M-51	Posterior ileocolic Anterior ileocolic	2 4	Posterior ileocolic	2
A261154	M-40	Posterior ileocolic	3	Posterior ileocolic	9
A165023	F-53	Posterior ileocolic	1	Posterior ileocolic	4

TABLE II.—*Continued.*  
*Summary of Group 2.*

Patients.....	32 (32 per cent.)
Females.....	8
Males.....	24
Average age.....	49.2 years
Posterior ileocolic glands involved.....	74
Posterior ileocolic glands not involved.....	192
Anterior ileocolic glands involved.....	34
Anterior ileocolic glands not involved.....	61
Appendicular glands involved.....	0
Appendicular glands not involved.....	9
Ileal glands involved.....	8
Ileal glands not involved.....	16
Glands involved.....	115
Glands not involved.....	281
Total number of glands.....	396
Average number of glands in specimen.....	12.3

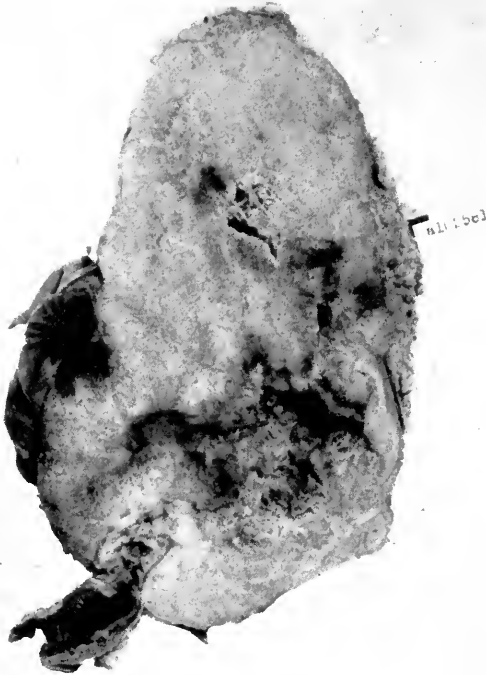


FIG. 9.—(102581). Massive colloid carcinoma which involved ileocecal valve and metastasized to regional lymph glands.

Cancers without local metastasis usually protrude into the lumen of the cæcum rather than penetrate its wall, while those with metastasis usually involve the walls.

The most common site for cancer of the cæcum is the posterior wall. Cases of annular cancer, or those in which all the walls were involved, comprised nearly 43 per cent. of this series. In 35 per cent. the growth was confined to the posterior wall. This accounts for the fact that metastasis and inflammatory reaction are most often found in the posterior ileocolic lymph glands. The growth was confined to the anterior wall in 13 per cent. of the cases.

Colloid cancer occurred in 20 per cent. of the cases. It metastasized in 12 per cent. and was often present in the most highly malignant cases.

The ileocecal valve was involved in 64 per cent. of the cases.

Sixty-six per cent. of the cases were males, and 34 per cent. females.

In 32 per cent. of the cases there was metastatic involvement of the regional lymph glands.



# LYMPH GLANDS IN CANCER OF THE CÆCUM

TABLE III.

*Group 3a. Colloid Carcinoma of the Cæcum Without Glandular Involvement.*

Case	Sex, Age	Location	Glands
A22895	M-48	Anterior ileocolic	4
		Posterior ileocolic	9
A274871	M-58	Anterior ileocolic	2
		Posterior ileocolic	7
A70127	F-40	Posterior ileocolic	8
A254414	F-63	Posterior ileocolic	11
A92504	M-43	Posterior ileocolic	5
A336867	M-56	Posterior ileocolic	6
		Anterior ileocolic	4
A339017	F-49	Posterior ileocolic	2
A303742	M-37	Ileal	3

## *Summary of Group 3a.*

Total number of patients.....	8 (8 per cent.)
Females .....	3
Males .....	5
Average age.....	48 years
Posterior ileocolic glands .....	48
Anterior ileocolic glands .....	10
Ileal glands .....	3
Total number of glands .....	61
Average number of glands in specimen .....	7.6

Lymph glands were found which were normal in consistency, yet palpable and plainly visible to the naked eye.

The size of the intestinal lesion, and the size and number of the regional lymph glands proved to be no criterion of the presence or absence of metastasis.

Lymph glands, simulating cancerous glands in size, due to marked cellular infiltration and lymphcedema, were found to be inflammatory.

Glands, too small to be palpated at the time of operation, were found to be the seat of metastasis.

In cases of glandular involvement large and numerous inflammatory glands were also noted, which could

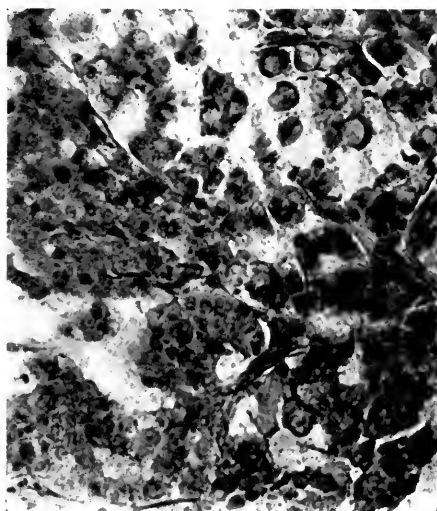


FIG. 10.—(A501909). Colloid carcinoma (signet-ring type). (X200.)

only be distinguished by the use of the microscope.

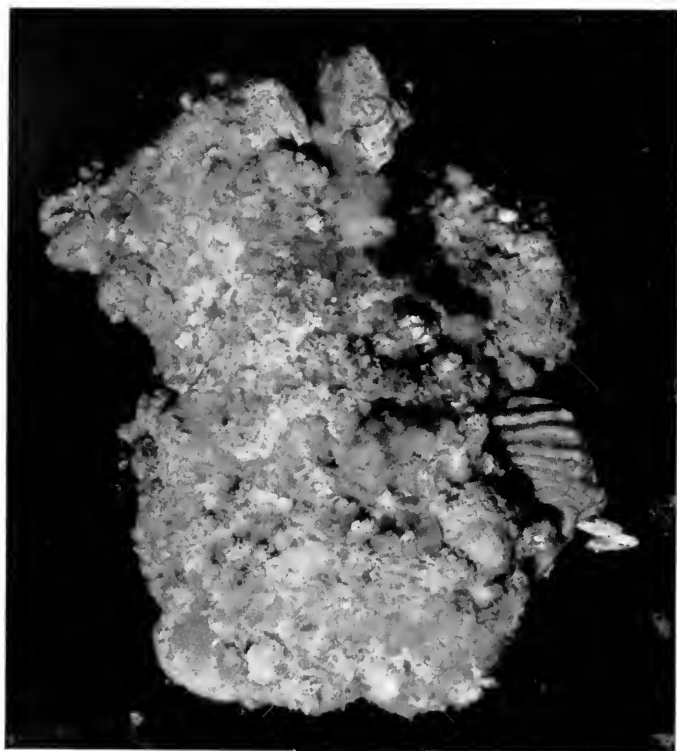


FIG. 11.—(A339017). Colloid carcinoma filling cæcum and involving ileocæcal valve; the regional lymph glands were free from metastasis.

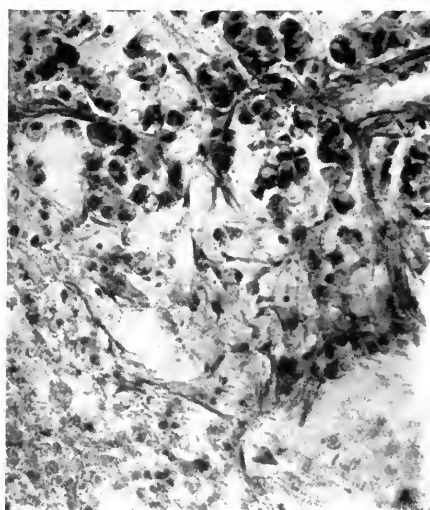


FIG. 12.—(294841). Metastasis in a lymph gland from colloid carcinoma. (X150.)

In cases of low malignancy clinically, without metastasis, were local glands, larger and more numerous than in the more highly malignant cases showing metastatic involvement.

In cases with a large number of glands involved pathologically, a high degree of malignancy was usually proved clinically.

Predominance of the posterior ileocolic lymph glands is of significance, and should prove of value in the operating room, since 71 per cent. of all glands found were in this region, and 64 per cent. of the glands which showed metastatic involvement belonged to this group.

Systematic microscopic examination is the only method of determining the presence of local or regional metastasis.

TABLE IV.

*Group 3b. Colloid Carcinoma of the Cæcum With and Without Glandular Involvement.*

Case	Sex, Age	With	Glands	Without	Glands
A144469	M-50	Anterior ileocolic Posterior ileocolic	5 8	Posterior ileocolic	1
A165146	M-53	Posterior ileocolic	2	Posterior ileocolic	9
A102581	M-49	Posterior ileocolic	1	Posterior ileocolic	9
A264202	F-57	Posterior ileocolic	3	Posterior ileocolic	4
A321512	M-68	Posterior ileocolic	2	Posterior ileocolic	6
A178416	M-20	Posterior ileocolic Anterior ileocolic	2 6	Posterior ileocolic	7
A160796	M-42	Posterior ileocolic	2	Posterior ileocolic	8
A126319	M-54	Posterior ileocolic	2	Posterior ileocolic	4
A299507	M-60	Posterior ileocolic	1	Posterior ileocolic	10
A213118	F-30	Ileal	4	Posterior ileocolic Ileal	5 4
A146060	M-68	Posterior ileocolic	8	Anterior ileocolic Posterior ileocolic	5 8
A207819	M-47	Posterior ileocolic	4	Posterior ileocolic	3

*Summary of Group 3b.*

Total number of patients.....	12 (12 per cent.)
Females .....	2
Males .....	10
Average age.....	49.3 years
Posterior ileocolic glands involved .....	34
Posterior ileocolic glands not involved.....	74
Anterior ileocolic glands involved.....	11
Anterior ileocolic glands not involved.....	5
Ileal glands involved .....	4
Ileal glands not involved.....	4
Glands involved.....	51
Glands not involved .....	93
Total number of glands .....	144
Average number of glands in specimen.....	12

## LYMPH GLANDS IN CANCER OF THE CÆCUM

### BIBLIOGRAPHY

- <sup>1</sup> Clogg, H. S.: Cancer of the Colon: A Study of Seventy-two Cases. *Lancet*, 1908, vol. ii, pp. 1007-1012.
- <sup>2</sup> Ewald: Quoted by Mayo, W. J.: Carcinoma of the Cæcum with Report of Cases in which the Cæcum was Removed for Malignant Disease. *Jour. Am. Med. Assn.*, 1901, vol. xxxvii, pp. 1019-1021.
- <sup>3</sup> Hayes, J. M.: The Involvement of the Lymph Glands in Carcinoma of the Large Intestine. *Minn. Med.*, 1921, vol. iv, pp. 653-663.
- <sup>4</sup> Jamieson, J. K., and Dobson, J. F.: The Lymphatic System of the Cæcum and Appendix. *Lancet*, 1907, vol. i, pp. 1137-1143.
- <sup>5</sup> MacCarty, W. C., and Blackford, J. M.: Involvement of Regional Lymphatic Glands in Carcinoma of the Stomach. *ANNALS OF SURGERY*, 1912, vol. lv, pp. 811-843.
- <sup>6</sup> McVay, J. R.: Involvement of the Lymph-nodes in Carcinoma of the Rectum. *ANNALS OF SURGERY*, 1922, vol. lxxvi, pp. 755-767.
- <sup>7</sup> Mayo, W. J.: Carcinoma of the Cæcum with Report of Cases in which the Cæcum was Removed for Malignant Disease. *Jour. Am. Med. Assn.*, 1901, vol. xxxvii, pp. 1019-1021.
- <sup>8</sup> Mayo, W. J.: Tumors of the Cæcum. *Jour. Lancet*, 1906, vol. xxix, pp. 523-527.
- <sup>9</sup> Mayo, W. J.: Surgical Cure of Cancer of the Gastro-intestinal Canal. *St. Paul Med. Jour.*, 1910, vol. xii, pp. 1-9.
- <sup>10</sup> Mummery, J. P. L.: Diseases of the Colon and their Surgical Treatment. New York, Wm. Wood, 1910, 322 pp.
- <sup>11</sup> Parham, D.: Colloid Carcinoma. *ANNALS OF SURGERY*, 1923, vol. lxxvii, pp. 90-105.

# CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD AND ADOLESCENCE

BY CHARLES HERBERT PHIFER, M.D.

OF CHICAGO, ILL.

FROM THE DEPARTMENT OF SURGERY, COLLEGE OF MEDICINE, UNIVERSITY OF ILLINOIS

It is generally considered that epithelial cancer of the terminal portion of the large intestine is confined to middle-aged and elderly subjects. This is undoubtedly true, since the number of such cases occurring in childhood and adolescence recorded in medical literature is strictly limited, and although some authors have admitted the occurrence of malignant disease in young persons they have commonly included sarcomas and other non-epithelial tumors.

Steiner,<sup>1</sup> in 1865, stated that Henning observed but 12 cases of cancer among 1,000,000 living children, under the age of 15 years, 6 of them between the ages of 5 and 10 years and 6 between 10 and 15 years. Von Bergmann<sup>2</sup> says that it is a remarkable fact that rectal cancer occurs in children, even in those less than 10 years of age, and he thinks it may perhaps be explained by the frequency of adenoid growths in children. Weinlechner<sup>3</sup> in 5279 cases of carcinoma observed 18 (0.34 per cent.) among children up to 14 years of age. Feldner<sup>4</sup> in 914 cases of carcinoma, met with only 3 up to the 16th years of life.

Inasmuch as authors differ somewhat in regard to the different pathological types of malignant tumors of the bowel and as the classification of tumors is largely arbitrary, Rose and Carless<sup>5</sup> suggest the following classification, which is based partly on the structure of the tumor and partly on the tissue from which it originates.

- |                           |                       |
|---------------------------|-----------------------|
| 1. Epithelial             | (a) Squamous-celled   |
|                           | (b) Epithelioma       |
| 2. Cuboidal or spheroidal | (a) Scirrhus          |
|                           | (b) Fibrous carcinoma |
|                           | (c) Hard cancer       |
|                           | (d) Acinous           |
| 3. Columnar               | (a) Cylindrical       |
|                           | (b) Malignant adenoma |
|                           | (c) Adenoid cancer    |
| 4. Medullary              | (a) Encephaloid       |
|                           | (b) Soft              |
|                           | (c) Acute             |

Columnar carcinoma is in the majority of cases a glandular cancer and is found more frequently in the alimentary canal. The so-called colloid cancer

TABLE I.  
*Synopsis of Reported Cases.*

Case No.	Reported by	Sex and age	Symptoms and diagnosis	Treatment and findings	Results	Remarks
1	Mayo, H. Observations on injuries and diseases of the rectum. 1853, p. 188	M 12	Not stated	Not stated	.....	This refers to a carcinoma of the rectum seen in a patient aged 12 years.
2	Bushe, G. Treatise on the malformations, injuries and diseases of the rectum and anus. 1857, p. 292	M 12	Not stated	Not stated	.....	Bushe states, "That he has seen the encephaloid transformation in a boy 12 years old."
3	Cummings, J. P. C. Malignant disease of the rectum in a boy of 12. <i>Am. Jour. Med. Sc., Phila.</i> 1854, lili, p. 352	M 12	Acute dysentery. Pain in rectum, frequent small discharges sometimes 20 per diem. 3 months later great tenesmus and inability to evacuate bowels. After using cathartics for 3 days without results, examination per anum showed tumor	Not stated. Autopsy findings colloid carcinoma	Death	The malignancy involved the entire circumference of the intestine more or less to the extent of 2 inches.
4	Pillon, A. Retractionnement cancéreux du rectum chez une jeune fille de seize ans et demi. <i>Bull. Soc. anat. de Paris.</i> 1856, xlii, p. 434	F 16½	Seriously ill for about 3 months. No abdominal antecedents. Obstinate constipation. Yielded only to energetic treatment. Stools glairy and bloody	Not operated; autopsy finding cancer.	Death	Autopsy: The rectum was thickened from the sacro-iliac symphysis to its ampullar dilation and invaded by a thick white tissue. The perirectal tissues were involved. Pathologically examined.
5	Steiner. Areolarkrebs des dickdarms bei einem neunjährigen Knaben. <i>Jahrb. f. Kinderh.</i> Leipz. 1865, vii, p. 61	M 9	Sudden crises of intestinal occlusion suggesting volvulus or invagination	Not operated; autopsy finding alveolar epithelial cancer	Death	Autopsy: Stenosis of the first portion of the iliac sigmoid. Microscopically verified.
6	Leijer. Enterotomi ved cancer recti. <i>Hygiea.</i> Stockholm. 1872, xxxix, p. 138	M 9	Previous history healthy and strong. Violent pain in abdomen from lifting a heavy weight. Digestive trouble and constipation followed. Patient constipated for 8 days, considerable meteorism and pain developed	Artificial anus. Autopsy finding alveolar epithelial cancer	Death 11 days later	Autopsy: Fistula led into upper part of sigmoid flexure. Intestines above not affected, but filled with fecal matter. S. Romanum filled with stone-hard lumps of feces. Rectum hard, fibrous, difficult to remove and it was adherent to the surrounding parts. Other abdominal organs anemic without cancerous deposits. Microscopically verified.

# CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD

7	Marchand. Etude sur l'extirpation de l'extrémité inférieure du rectum. Paris. 1873. Case quoted by Schoening	F 12	Tumor in anus from 10th to 13th year; disappeared then. Past 9 months pain in rectum and abdomen and bloody stools. Tumor felt on inserting finger in rectum; ring formation in lower part of rectum with stenosis	Tumor first treated by crushing. Later extirpation. Carcinoma	Death by suppuration and peritonitis	No mention of the nature of tumor. Schoening thinks sarcoma can be excluded and that it was similar to a case of rectal carcinoma observed in the Rostock Clinic.
8	Mollière, D. Traité des maladies du rectum et de l'anus. 1877, p. 565	F 19	Tumor primarily developed in the rectum with rapid ascending extension along the intestine in the region of the iliac sigmoid	Cancer	Death	No further particulars.
9	Godin. Quoted by Mollière. <i>Ibid.</i> , p. 520	15	.....	.....	.....	Godin observed a case of scirrhous cancer in the rectum in a child 15 years old.
10-12	Billroth. Th. Chirurgische Klinik. Berl. 1878, p. 490	18-20	.....	.....	.....	Billroth mentions 3 cases of carcinoma of the rectum in patients from 18-20 years old. No details given.
13	Allingham. Diseases of the rectum. 1879, 3d. ed. p. 205	M 17	.....	.....	Death	Allingham saw an encephaloid rapidly fatal in a lad 17 years old.
14	Gowland. Quoted by Allingham. <i>Ibid.</i>	M 13	.....	.....	.....	Gowland observed a case of cancer of the rectum in a boy 13 years old.
15	Dubar, L. Carcinome colloïde de l'Siglaque chez un jeune homme de 19 ans. Laparotomie anus contre nature. Bull. et mém. Soc. anat. de Par., 1879, liv. p. 644	M 19	No important antecedents. Sudden abdominal pains, vomiting and diarrhoea. Did not persist and only slight for next 2 months. Some constipation, nausea and pains; bilious vomit. Constant purgatives necessary	Laparotomy. Artificial anus. Autopsy findings. Colloid cancer	Death	Autopsy: Tumor size of egg occupied the middle part of the iliac sigmoid colon. Intestinal walls much thickened about tumor. No trace of metastases. Microscopically verified.
16	Alfeld. Arch. f. Gynaek. Berl. 1880, xvi, p. 141	Newborn monster	.....	Autopsy finding cancer	Death	Case of a newborn monster. Tumor at termination of large intestine. Microscopically cancer.
17-18	Gurli, E. Beitrage zur chirurgischen statistik. Arch. f. klin. Chir. Berl. 1880, xxv, p. 421	13-19	.....	.....	.....	Gurli observed 2 cases of carcinoma of the rectum. No details given.
19	Forbes. Quoted by Cripps. Cancer of the rectum. London	M 17	.....	Not stated	Death	The progress of the disease was so rapid in this case that the period from the onset of the symptoms to death was only 8 months

TABLE I.—Continued.  
Synopsis of Reported Cases.

Case No.	Reported by	Sex and age	Symptoms and diagnosis	Treatment and findings	Results	Remarks
20	Heuck, G. Zur statistik und operative behandlung der mastdarmkrebs. Verhand. d. deutsch. Gesellsch. f. Chr. 1883, xii, p. 183	18	Bowels moved with great difficulty, accompanied by extreme pains in back and abdomen, and discharge of mucus	Operation. Thermo-cautery and later colotomy. Autopsy finding, gelatinous-cylindric cell carcinoma	Died of exhaustion	Duration of illness 17 months.
21	Hayd, H. Scirrhus cancer of the rectum in a boy 18 years old. Buffalo M. and S. J. 1883, xxii, p. 497	M 18	Chronic diarrhoea. Pale, anemic, emaciated. For 1½ years uneasiness and pain on defecation, passed blood occasionally. Eventually a violent and nearly fatal hemorrhage. Pain increased, hemorrhages repeated attacks of constipation with diarrhoea, accompanied with great tormina, and at last tenesmus	Palliative laxatives and morphia. Operation impracticable	Death	Notwithstanding the large size of the growth and the involvement of the abdominal lymphatics, those in the groin along Poupart's ligament and beneath it and in Scarpa's triangle were unaffected.
22	Schoening, G. Ueber dar Vorkommen des mastdarmkrebs in den ersten beiden Lebensdecennien. Deut. Ztschr. f. Chr. Leipz. 1885, xxii, p. 36	F 17	Gastro-intestinal trouble since 7th year, mucus in the stools defecation difficult and usually accompanied by bleeding, sometimes clots. Examination showed the rectum and lower colon strictured, hard and infiltrated and bled easily; a mass between rectum and vagina. Diagnosed as rectal carcinoma	Extirpation of mass. Autopsy findings. Alveolar celled carcinoma	Death	Autopsy: Lower part of rectum and sigmoid flexure strongly stenosed and walls infiltrated and adherent to sacrum, uterus, etc. Microscopically verified.
23	<i>Ibid.</i>	F 17	Constipated, feces passed with difficulty. A movement in 8 days only with great pain. Tumor in vicinity of the tuberosity of the ischium and posteriorly to coccyx; labia oedematous, tumor not movable. Pushing of finger in rectum difficult; a hard ring could be felt in the posterior rectum; lumen of rectum much stenosed	Exploratory operation. Biopsy: Cylindric cell carcinoma	Death	No autopsy. Obstinate obstipation was the noteworthy early symptom in this case. Microscopically verified from biopsy.



# CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD

24	Michaux, Trans. Acad. Med. Richmond, Va. 1890. Quoted by Williams	M 15	.....	.....	.....	.....	.....	Michaux saw a case of colloid carcinoma of the rectum in a boy 15 years old.
25	Hastings. Quoted by Cripps	M 18	Duration of illness 4 months	Colotomy	Patient lived 10 months after operation	.....	.....	Mother of patient also died of rectal cancer 5 years after his death
26	Wilde, M. Ueber das Vorkommen des Krebs bei jugendlichen Individuen. Inaug. Diss. Kiel. 1892, 19 pp.	M 15	.....	.....	.....	.....	.....	No details given. The author saw a case of cancer of the rectum in a boy 15 years old.
27	Israel. Quoted by Phillipis. 1892	M 14	.....	.....	.....	.....	.....	Israel saw a case of colloid cancer in the sigmoid flexure in a boy 14 years old. No details.
28	Stern, C. Zur Kenntniss maligner Neubildungen im Kindersalter deutsche med. Wchnschr. Berl. 1892, xviii, p. 494	F 11	Ileus.	Operated. Cylindric cell carcinoma	Death	.....	.....	In the rectum, about 10 cm. from the anus a circular 4 cm. high growth pressing against the intestinal wall having on its lower surface a number of small nodules. Microscopically verified.
29	Platt, J. F. On excision of the rectum for cancer with records of 21 cases. Med. Chronicle. 1894, n. s. i, p. 419	M 19	Symptoms of rectal disease for 8 months before admission. Tumor involving the posterior wall of the rectum 1½ inches above anus	Operation. Bowel resected including tumor. Epithelioma	Recovery	.....	.....	3 inches of bowel removed.
30	Czerny. Mastdarmkrebs bei einem 13 Jahr. Knaben. München. med. Wchnschr. 1890, xliii m. p. 241	M 13	Tumor developed in large intestine during last 1½ years	Operation. Cylindrical epithelial cancer	.....	.....	.....	Tumor reached some 4 inches into intestinal canal. The growth extended to Douglas sac through the muscularis.
31	Garrard, W. A. Case of carcinoma of the colon occurring in a child. Quart. M. J. Sheffield 1896, v, p. 234	M 12	Constipation until last 6 days. Complete obstruction with pain, vomiting, distention, passed no blood or mucus. Abdomen distended and tympanic, visible peristalsis, distended bowel felt pressing into the rectum, no stricture felt	Operation. Sigmoidal tumor. Autopsy findings. Colloid columnar cell carcinoma	Death	.....	.....	On account of the age cancer not surmised. Autopsy: Growth in sigmoid had closed it completely for 1½ inches, meso-colon infiltrated. Cæcum, appendix, and a coil of ileum adherent to abdominal wall by a deposit growth. Microscopically verified.
32	Matthews, J. M. Quoted by Tuttle	F 17	.....	Carcinoma	Recovery	.....	.....	Recurrence in 2 years.
33	Csesch P. Beitrag zur Statistik der Rektumcarcinoma Inaug. Diss. Breslau. 1897	M 18	Blood in stools since childhood. Diarrhoea for 8 months	.....	.....	.....	.....	Csesch includes in his statistics 1 case of rectal carcinoma in a youth of 18.

TABLE I.—Continued.  
Synopsis of Reported Cases.

Case No.	Reported by	Sex and age	Symptoms and diagnosis	Treatment and findings	Results	Remarks
34	Paulauf, R. Carcinom der Flexura sigmoidea von einem zwölfjährigen Mädchen. Wien. klin. Wchnschr. 1900, xiii, p. 197	F 12	.....	Autopsy findings. Cyclindric cell epithelioma	Died of acute ileus	Tumor of the sigmoid with metastases in liver and peritoneum found at autopsy. Microscopically verified.
35	Zupinger. Der Darmkrebs im Kindesalter. Wien. klin. Wchnschr. 1900, xiii, p. 389	F 12	Suffered for 3 months from abdominal pains; diarrhoea; melena, tense painful abdomen; anal fissure. Tumor palpated rectum. Absolute constipation	Autopsy findings. Cyclindric cell epithelioma	Death	Metastases in liver and peritoneum of sigmoid. Microscopically verified.
36	Marsh, F. Carcinoma of the sigmoid flexure in a boy aged 15 years. Lancet. Lond., 1902, i, p. 379	M 15	Pain in epigastrium and passing of blood in stools, 6 months prior. Per rectum an indistinct fulness could be felt to the left in the rectovesical pouch. Blood and mucus followed examination	Operated. Growth excised, as well as enlarged glands; intestine anastomosed to upper part of rectum. Columnar cell carcinoma	Recovery	Microscopically verified.
37	Parkinson, J. P. Colloid cancer in a girl of 12. Lancet. Lond., 1903, i, p. 1525	F 12	Abdomen was distended with free fluid; thought to be suffering from tuberculous peritonitis	Autopsy finding. Colloid cancer	Death	The primary seat of the growth believed to have been the rectum. Microscopically verified.
38	Rohde, E. Über Krebs im jugendlichen Alter. Inaug. Diss. Griefswald. 1904	M 19	Blood in stools since childhood. Anal tumor appeared after defecation and had to be pushed back. Pain later with blood and mucus in stools	Operated for polyps by galvano operation and thermo-cautery. Radical operation with artificial anus. Cancer	Death	Microscopically verified.
39	Grulee, C. G. Carcinoma in early life with the report of carcinoma of the rectum in a girl 16 years old. Surg. Gynec. & Obst. Chicago. 1906, ii, p. 678	F 16	Patient weak and undeveloped since birth. Pain in lower part of abdomen, more severe in left iliac region, bright red blood in stools. Very constipated, anorexia and vomiting	Adenocarcinoma	.....	Microscopically verified from biopsy.
40	Lazarus-Barlow, W. S. "Cancer Ages." A statistical study based on the cancer records of the Middlesex Hosp. Arch. Middlesex Hosp. London. 1905, v, p. 30	M 16	Digital examination revealed a large growth in the rectum	Colloid	Death	Diagnosis not confirmed by autopsy or microscopic examination.

# CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD

41	Bernouilles. Magen-Darmlkrebs in den beiden ersten Lebenszeihen. Inaug. Diss. Biele. Quoted by Baur and Bertin	M 15	Case diagnosed as invagination	Not operated. Autopsy finding alveolar carcinoma	Death	Autopsy: Peritonitis; stenosis (11 cm.) of superior part of sigmoidal loop. Microscopically verified.
42	Cripps, Harrison. Diseases of the rectum and anus. 1907	M 14	Duration of illness 2 months. Mass felt 3 inches above anus	Palliative	Died 3 months later	.....
43	Clogg, H. S. Cancer of the colon, a study of 72 cases. Lancet. Lond. 1908, ii, p. 1007	15	.....	.....	.....	Of the 72 cases of colon cancer collected by Clogg one was in a child aged 15 years.
44-47	Porter, M. F. Cancer of the rectum and lower sigmoid, with the report of a Unique case. New York M. J. 1912, xciv, p. 264	14-17	.....	.....	.....	Porter states that of 115 cases of cancer of the rectum at the Rostock Clinic, 4 occurred in patients between 14 and 17 years of age.
48	Barber, W. H. Intestinal obstruction caused by adenocarcinoma of the sigmoid in a boy of 19. Interstate M. J. St. Louis. 1919, iii, p. 106	M 19	Symptoms of acute intestinal obstruction. Suffered from intestinal cramps. Always constipated, but no pain upon defecation until the past year. Vomited persistently for 2 days before entering hospital. No blood in vomitus, nor in colonic washings. Abdomen markedly distended, generally rigid and tender	Operated carcinoma	Operative recovery	Extensive glandular metastases in the mesosigmoid and in the preaortic lymphatics. Microscopically verified.
49	Olmsted, I. Carcinoma of the lower part of the sigmoid in a boy 14 years of age. Tr. Am. Surg. Assn., Phila. 1921, xxxix, p. 24	M 14	Pain in abdomen, frequent stools of blood and mucus, with rectal tenesmus	Operation. Adenocarcinoma	Recovery	Histological examination showed varied forms of atypical growth of gland epithelium and epithelial cells. Microscopically verified.

results from a degeneration of the epithelial cells of a glandular cancer and is thus found associated with epithelioma, scirrhus, medullary and columnar cancer and should be so regarded instead of a separate type as mentioned in some of the appended reports.

The site of the lesion is usually three or four inches above the anus, although it is frequently found in the rectal pouch.

I have recently observed the following case, which was referred to me by my assistant, Dr. I. Kaufman.

Male, aged nineteen. Previous illness, negative until six months ago, when he began to lose weight, which has lately been so rapid that it caused him to discontinue his employment three weeks ago, since which time he has had a pronounced diarrhœa, six to twelve stools per day, consisting largely of mucus and shreds, rarely, but occasionally, stained with blood. There was a marked anorexia, distention, tenderness, frequent vomiting, severe pain in abdomen and frequent micturition.

Physical examination: Temperature, 100; pulse, 100; respiration, 22. Marked emaciation, facial expression markedly hippocratic. Abdomen greatly distended, board-like rigidity, tympanitic, slight œdema of the lower limbs, slight dullness in both flanks, pronounced tenderness over entire abdomen more so in left iliac region. Rectal examination, empty, negative to palpation. Blood findings: Red blood cells, 2,760,000; white blood cells, 13,200; hæmoglobin, 60; coagulation, 5 minutes. Differential count: Polymorphonuclears, 74 per cent.: small lymphocytes, 24; large, 2 per cent. Achioma present. Poikilocytes present. No other pathological cell changes. Urine highly acid, otherwise negative. Diagnosis of partial obstruction possibly due to tubercular peritonitis was made, and operation advised and accepted.

Operation: Midline celiotomy inspection showed entire colon distended about size of his thigh, abdominal cavity filled with a sero-purulent fluid with mass causing obstruction located in sigmoid. An emergency drainage was established in the iliac colon and wound partly closed. Patient expired eighteen hours later.

Autopsy revealed a hard, irregular tumor mass, located about middle of the pelvic colon, firmly adherent to bladder and surrounding structures. Growth causing almost complete closure of sigmoid. A few abdominal lymphatic glands and mesenteric glands enlarged. Histological examination showed the tumor mass to be a columnar carcinoma.

*Resumé.*—Rapidly developing and fatal columnar carcinoma of the sigmoid in a male patient nineteen years, the chief symptom, being abdominal pain, vomiting, distention and diarrhœa.

Bernouille,<sup>6</sup> in 1907, reviewing 50 cancers of the digestive tract in subjects less than 20 years old, found that 29 involved the sigmoid or rectum. Many of these cases do not appear to have been verified.

In a careful search through the literature I have found 49 cases of cancer of the rectum or sigmoid in children and adolescents under 20 years old; resumé of each is to be found in the appended Table I; 23 were in males,

## CANCER OF THE RECTUM AND SIGMOID IN CHILDHOOD

13 in females, and in 13 cases the sex is not stated. The age incidence is as follows:

Under 1 year (monster) .....	1
From 1 to 5 years .....	0
From 6 to 10 years .....	1
From 11 to 15 years .....	22
From 16 to 20 years .....	25
Total .....	49

*Etiology.*—In the young as in the adult, intestinal cancer of the lower digestive tract seems to have a marked predilection for the sigmoid. This perhaps may be explained by the fact that in the young the rectal region is more adapted as a region where intestinal contents stagnate than other portions of the intestine. Traumatism is only very exceptionally noted as a cause either revealing a lesion up to the latent or else aggravating a pre-existing neoplasm.

What strikes one in reading the histories of these cases is the rapidity of evolution of the cancer. From the time that the first symptoms were clearly evident until death 7 to 8 months, rarely more elapsed. The affection in the young is therefore almost fulminating.

*Symptoms.*—The early symptoms of cancer of the rectum are often very obscure, and vary according to the situation of the growth, and ulceration involved. The established symptoms are constipation, diarrhœa, tense, tympanitic abdomen, gastro-intestinal disturbances, pain, melena, and intestinal occlusion. Pain is usually the earliest symptom, being generalized over entire abdomen, as in the case reported. Melena is more or less frequent. Usually the case sooner or later shows acute ileus, and more especially when the cancer is in the sigmoid. The well-developed musculature of the sigmoid predisposes it to spasm which causes the acute occlusions in cases of cancer. In several instances obstinate constipation was noted, but on the other hand diarrhœa, as in the present case, was more prominent. Rectal palpation does not usually furnish any clear indications; in the present case it was negative.

*Diagnosis.*—Of the 49 cases only 7 were pre-operatively diagnosed as cancer; in 1 the diagnosis was uncertain; 1 was diagnosed as invagination; 2 as obstruction; 1 in a newborn monster; 13 were found post-mortem, and in 23 cases no diagnosis is stated. The young age of the patient generally excluded the idea of cancer.

*Course.*—Of the 49 cases, 26 died, 3 recovered, and in 20 the result is not clearly stated.

*Metastases.*—Metastases of rectal and sigmoidal cancer are rare in young patients and were observed clinically on palpation in but very few cases. They were usually autopsy findings, more particularly noted in the liver, mesentery, lung, spleen, peritoneum, and lymph-glands, the last being the most frequent.

*Treatment.*—Palliative treatment offers very little in these cases. The majority of these cases are not diagnosed until late if at all. In many of them the abrupt onset of the terminal acute clinical history precludes the possibility of anything except radical interference.

The application of radium intra-sigmoid or intra-abdominal is of doubtful value, even in the most favorable cases—possibly as a preparation for operation—this is, however, questionable. The use of deep X-ray therapy is in its infancy and remains to be developed.

However, supportive feeding and elimination should not be overlooked. The diet should be bland and non-irritating, consisting of milk, fruit juices, concentrated liquid foods. Elimination should forbid cathartics and rely upon clysters of oil and water under low pressure, precaution should be taken not to damage or perforate the intestinal wall. The use of antiseptics is likewise commended.

The operative measures employed have usually been the procedures well established in such cases. The establishment of an artificial anus, colostomy, and resection of the neoplasm with the portion of the intestinal tract involved. When indicated, if the patient is in a good general state, colectomy offers the best chance of complete success and avoidance of recurrence; if the neoplasm is not far advanced in evolution and the system not yet intoxicated, resection should give favorable results in young patients.

Of the 49 cases here reported 15 were operated; of these 8 died post-operatively; in 1 the result is not stated. There were 3 post-operative recoveries, of which 1 is stated to have died within a short time later.

## REFERENCES

- <sup>1</sup> Steiner: *Jahr. f. Kinderh.*, 1865, vol. vii, p. 61.
- <sup>2</sup> Von Bergmann: 1904, vol. v.
- <sup>3</sup> Quoted by Olmsted: *Tr. Am. Surg. Assn.*, 1921.
- <sup>4</sup> Quoted by Olmsted: (*Ibid.*).
- <sup>5</sup> Rose and Carless: *Manual of Surgery*, 10th ed., 1922.
- <sup>6</sup> Bernouille: *Inaug. Diss.*, Bâle, 1907. (Quoted by Bauer and Bertein.)
- <sup>7</sup> Baur, J., and Bertein, P.: *Arch. gen. de chir.*, 1914, vol. x, p. 675.
- <sup>8</sup> Philip, W.: *Zeit. f. Krebsf.*, 1907, vol. v, p. 370.
- <sup>9</sup> Tuttle, J. P.: *Jour. Amer. Med. Assn.*, 1897, vol. xxviii, p. 579.
- <sup>10</sup> Williams: *Natural History of Cancer*, 1908.
- <sup>11</sup> Schoening, G.: *Deutsche. Zeit. f. Chir.*, 1898, vol. xxii, p. 36.

## SARCOMA OF THE OMENTUM

BY GLOVER H. COPHER, M.D.

OF ST. LOUIS, MO.

FROM THE DEPARTMENT OF SURGERY, WASHINGTON UNIVERSITY SCHOOL OF MEDICINE

PRIMARY tumors of the omentum are rare and primary sarcoma of the omentum is extremely rare. Text-books of surgery and pathology give remarkably little on the subject. Some authors deny that sarcoma is ever found as a primary growth in the omentum and claim sarcoma found there to be secondary to that of the peritoneum, stomach or colon. The few recorded cases are sufficient to prove its existence as a primary tumor of the omentum. Carcinoma is not primary in the omentum. Such growths are either secondary carcinoma or endothelioma. The gross appearance of the different omental malignant tumors may be very similar. While such tumors may be very vascular, they tend to disorganize and the cells to disintegrate into gelatinous material, as so frequently seen in metastatic carcinoma or so-called colloid cancer. Cyst formation of omental tumors is frequent. Hemorrhages into such cysts have been described a number of times. Hydatid and dermoid cysts occur; the great omentum being an extremely favorable situation for hydatid cysts. Other benign tumors of the omentum are lipoma, fibroma and lymphangioma. They seem to occur less frequently than sarcoma.

In 1906, Cobb collected reports of 14 authentic cases, including one of his own, of primary sarcomata of the omentum. Bonamy and Bonamy in 1908 collected the reports of 16 cases and Karsner in 1911 reported an additional collection of 7 cases and added as his own a report of a primary endothelioma of the great omentum. Sten von Stapenohr in 1918 succeeded in collecting 49 primary sarcomata of the omentum. Aimes in 1920 reports a total of 53 such tumors. Smital and Segers each have recently reported cases. The total number of reported cases is probably still below 60.

The following is a report of another primary sarcoma of the great omentum with metastasis to the liver:

*Case Report.*—Surgical No. 11465, negro, male, forty-four years of age, was sent to the Barnes Hospital from the Washington University Dispensary with the diagnosis of carcinoma of the stomach. His chief complaint was vomiting, pain in abdomen, weakness and loss of weight. Onset of illness was two months prior to admission to the hospital with vomiting and severe abdominal pain associated with chills and fever. The vomitus was generally of the "coffee-ground" type. Approximately five weeks later he noticed an increase in the size of his abdomen. The enlargement of the abdomen increased and he continued to have intermittent vomiting, abdominal pain and loss of appetite and weight.

Examination showed him to be poorly nourished. Breath sounds were diminished at the base of the lungs. The abdomen was distended and an indefinite

tender mass could be palpated in the upper left quadrant extending over to the midline. The mass moved with respiration. The liver edge was palpable 6 cm. below the costal margin. The surface of the liver was rough and tender. There was dullness on percussion over the entire left abdomen and in the right flank a fluid wave was demonstrated. Genitalia, extremities and rectal examination negative.

Blood Wassermann negative. Blood-pressure 130-90. Phenolsulphonephthalein excretion, 45 per cent. in two hours. Red blood-cells, 3,500,000; white blood-cells, 14,000; hemoglobin, 80 per cent. Sahli. Temperature, 37° C.; pulse, 132; respiration, 24. Urine showed a trace of albumen and contained many white blood-

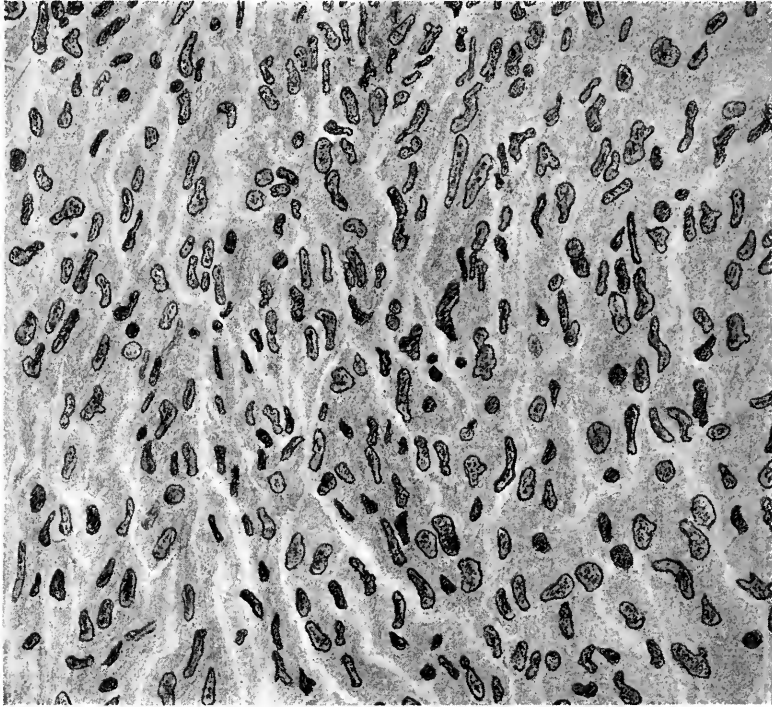


FIG. 1.—Drawing showing a typical section of sarcoma of omentum.

cells. Stool examination negative. Stomach analysis, fasting content of 200 c.c. of bile-stained fluid with a deficit of free HCl. Gastro-intestinal X-ray examination showed a large intra-abdominal, extra-alimentary mass with ascites.

An exploratory laparotomy was made by Dr. E. A. Graham. The abdomen was opened by a left upper rectus incision, allowing to escape a large amount of bloody fluid. A tumor was found lying beneath the stomach. Many adhesions were present and the viscera were swollen and œdematous. In order to inspect the mass better, an opening was made through the mesocolon. There escaped through this opening a large amount of old blood, followed by fresh blood. About 1500 c.c. of fluid escaped. Because of this fluid, a satisfactory inspection or removal of tissue for diagnosis could not be done. The cavity was packed with gauze and the abdomen closed about it.

Post-operatively the patient was given a transfusion of 700 c.c. of blood.



## SARCOMA OF THE OMENTUM

Following the operation he improved and for a time was able to be up in a wheel chair. He soon became weaker, however, developed pulmonary symptoms without chest findings, and died two months after admission to the hospital.

Autopsy No. 1883, by Dr. Hiram Liggett. On opening the abdomen a large new growth was encountered filling the entire upper abdominal cavity, displacing the intestinal coils downward and the liver to the right and upward. The bulk of the tumor lay on the left side. The tumor mass was yellow in color, convoluted and was covered with many blood-vessels. It resembled a normal brain surface and was of soft consistency. The upper part of the tumor covered the stomach and spleen. Low down on the anterior surface of the mass were folds of the great omentum. The lesser peritoneal cavity was obliterated. Mesocolon normal. Posteriorly the tumor was found to bear the same relations to the great omentum as it did in front, *i.e.*, lying within its folds shortly after it left the greater curvature of the stomach. The tumor mass was very vascular and there was extensive necrosis present. The liver lay in contact with the tumor and in the left lobe there was an accumulation of metastatic nodules. Stomach, pancreas, spleen, kidneys and adrenals free from tumor. The left-sided position of the tumor and the appearance of the liver were against the hepatic origin of the new growth.

Microscopic study of several sections of the primary growth show it to be made up of a mass of cells with large, oval nuclei, containing mitotic occasional figures (Fig. 1). The cytoplasm in most cells is inconspicuous and fine fibres run between the poles of adjacent cells. The cells are of uniform shape and character with a fascicular arrangement. The sections show many blood-vessels and some necrotic areas surrounded by infiltration of polymorphonuclear cells. Sections through the secondary tumors of the liver show tissue identical with that of the primary growth. Mediastinal, retroperitoneal and mesenteric lymph-glands do not show involvement with tumor.

Diagnosis made of spindle-cell sarcoma of the great omentum with invasion of the liver.

From a study of the reported cases, primary sarcomata of the omentum are found to occur more commonly in females than males. Most of the cases have been in the white race and between the years of thirty-one and sixty. The symptoms and signs vary widely and usually give no clew to the true pathology. Most cases have had a latent period with symptoms suggesting gastro-intestinal disease, as intestinal obstruction, cancer of the stomach, etc. Accompanying the slow onset there is a loss of weight, abdominal pain and constipation which may alternate with diarrhoea. When the tumor becomes palpable there is usually associated ascites, distention and the progress of the disease becomes rapid. The anæmia and cachexia are usually not marked.

Tumors of the omentum attain great size and they are movable early in their course. A primary sarcoma of the great omentum was found in the sac of a left scrotal hernia. Metastases are uncommon and direct invasion is not widespread. All varieties of sarcoma have been found in the omentum, but the spindle-cell type has been the most common. Cystic tumors of the omentum may be confused with cysts of the pancreas, liver, ovaries, urachus and mesentery. Solid tumors of the omentum have been difficult to diagnose before operation.

BIBLIOGRAPHY

- Cobb, F.: Primary Sarcoma of the Omentum. *ANNALS OF SURGERY*, vol. xlv, 1906, p. 16.
- Bonamy, R., and Bonamy, E.: *Rev. de gynec. et de chir. abd.*, vol. xii, 1908, p. 285.
- Karsner, H. I.: A Case of Primary Endothelioma of the Great Omentum. *Jour. Am. Med. Ass'n*, vol. lvi, 1911, p. 1871.
- Sten von Stapenohr: Ueber primäre Sarkome des Omentum majus. *Nord. med. Arkiv.*, Abt. 1, p. 1.
- Aimes, A.: Les tumeurs du grand epiploon. *Le Progres Medical*, Janvier 4, 1920, p. 1.
- Smital, W.: Ein Fall von primärem Sarkom des Omentum majus. *Wiener klin. Woch.*, January 12, 1922, p. 33.
- Segers, A.: Sarcoma of Omentum in Girl of Ten. *Archivos Latino-Amer. de Pediatric*, vol. xvi, October, 1922, p. 662.

## CONGENITAL DIAPHRAGMATIC HERNIA

BY JOHN F. CONNORS, M.D.

AND

WILLIAM T. ROBINSON, M.D.

OF NEW YORK, N. Y.

UNTIL the advent of radiography diaphragmatic herniæ were very infrequently recognized during life; but of late this condition has been noted more frequently by this means of examination and more cases are being recorded in the literature. Siebert, in his review of the literature of this subject in 1916, had found 252 cases. Since that time a number of cases have been reported by various authors. In the cases noted by far the larger number were the result of trauma; those of congenital origin are relatively few. The following case is of interest in this respect:

*Case Report.*—The patient, O. P., a young female was admitted to the surgical service of Doctor Connors at Harlem Hospital with the following history: About 6 P.M. on the day of admission, October 9, 1922 patient fell while roller skating, striking the back of her head. She did not lose consciousness, she became dizzy and was unable to walk unassisted. She was admitted with a tentative diagnosis of a fractured skull.

Previous history which was obtained from the mother was as follows: Has had the usual diseases of childhood. For the past three years the child has suffered from a gastric disturbance which has become progressively worse, so that for the last year and a half the patient has had to lie down for an hour after each meal, to relieve the discomfort.

Physical examination revealed a normally developed female about thirteen years old, not acutely ill. No loss of muscular power and fully conscious, complaining of headache which is confined to the occipital region.

*Physical examination* revealed eyes, ears, nose and throat negative. Cervical glands slightly enlarged. The chest showed slight bulging of left side posteriorly. The circumference at the level of the angle of scapula at inspiration is  $74\frac{1}{2}$  cm. and at expiration is 70 cm. Left side at median, inspiration is  $37\frac{1}{2}$  cm. and the right side is  $34\frac{1}{2}$  cm. Percussion on the left side reveals moderate dullness over the lower lobe posteriorly and anteriorly, except over the normal area of cardiac dullness which in this case is tympanitic. There is diminution of respiratory murmur all over the left chest.

The area of normal cardiac dullness on left side is replaced by tympany. After patient drinks one pint of water this area becomes dull to percussion. Cardiac impulse is felt more strongly on the right side. Apex is apparently over the fifth rib on right side  $4\frac{1}{2}$  cm. from mid-sternal line. No thrills noted. The heart percusses on right side from the 3rd rib to the 5th rib and extends outward  $7\frac{1}{2}$  cm. from the median line. The sounds are heard more distinctly on the right side and most distinctly over point of maximum cardiac thrust, 5th rib,  $4\frac{1}{2}$  cm. from mid-sternal line. The sounds are of good muscular quality. Second sound is accentuated over third space to right of sternum. No murmurs detected.

Examination of abdomen reveals an area of tympany in right upper quadrant

corresponding to stomach. After drinking one pint of water this area becomes dull. Mass felt in right side extending from hypochondriac region to a point  $3\frac{1}{2}$  cm. below umbilicus and practically filling up right side of abdomen. Ex-

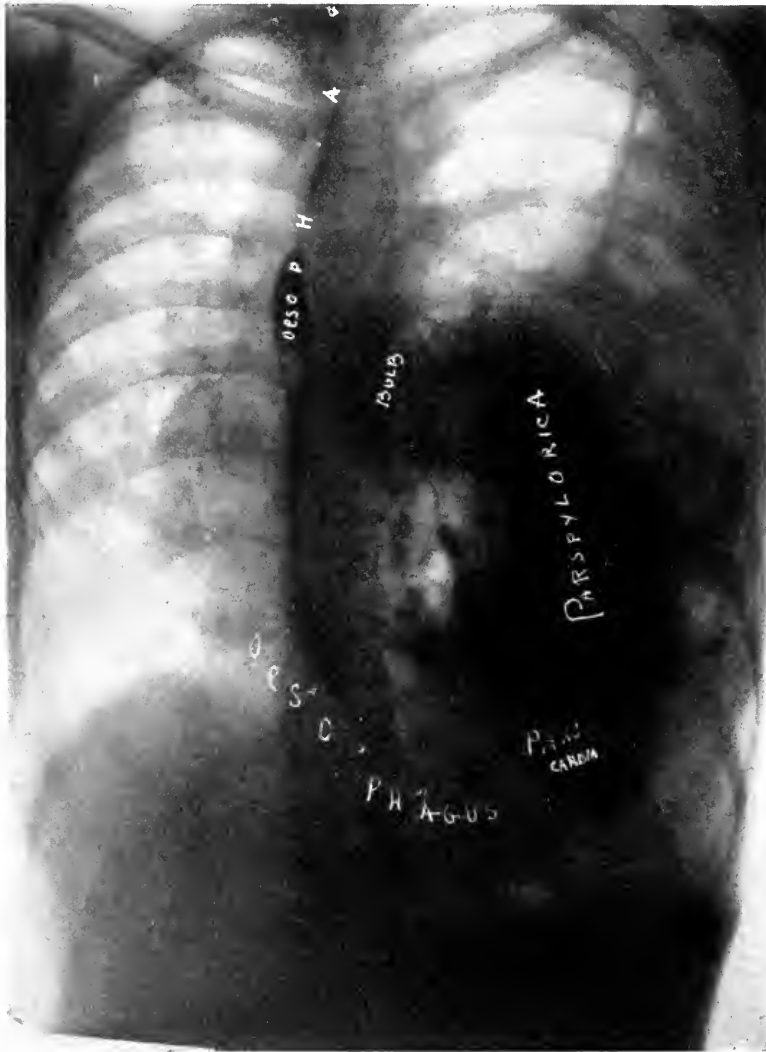


FIG. 1.—The esophagus, stomach and duodenum outlined. Note relation of the stomach. The pars cardia occupies a lower position than the pars media.

tremities and reflexes normal. Urine examination is negative. Blood count: Red blood-cells 4,600,000; hæmoglobin 85 per cent.; white blood-cells 6,400; Polymorphonuclears 60 per cent. Lymphocytes 40 per cent.

X-ray examination by Doctor Robinson showed no evidence of a skull fracture. The lower poles of both kidneys were found to be at the level of the transverse processes of the third lumbar vertebra, both kidneys being normal in size and shape. Fluoroscopic and radiographic examinations of the chest revealed absence of pul-

## CONGENITAL DIAPHRAGMATIC HERNIA

monary markings in the left side excepting its upper third. The diaphragmatic excursion on the right side was normal; the dome of the left side could not be distinguished. The heart is displaced to the right and partially rotated on its axis.

Examination of the œsophagus by means of the opaque mixture revealed



FIG. 2.—Barium enema. The upper portion of the descending colon, the splenic flexure, the transverse colon and ascending colon lie within the left chest wall.

the meal to pass down into the œsophagus and back into the thoracic cavity where it empties into the pars cardia. The stomach is also rotated on its axis so that the pars pylorica and bulbus duodeni are higher in position than the pars cardia (Fig. 1). When the patient is lying on her left side the pars cardia, the pars pylorica, and the bulb assume their normal relation. This

explains why the patient has to lie down for an hour after each meal to relieve discomfort. The relation of the pars cardia and the pars pylorica is probably responsible for the six-hour gastric retention. The jejunum and ileum are also in the thoracic cavity. Examination of the colon by means of barium enema reveals the rectum, sigmoid, and the lower part of the descending colon to occupy respectively the pelvic and abdominal cavities, the thoracic cavity containing the upper portion of the descending colon, splenic flexure, transverse and ascending colons and cæcum (Fig. 2). The liver is in the abdominal cavity and is also rotated on its axis, so that it lies longitudinally instead of in its usual transverse position. The left lobe of the liver is palpable at the level of the transverse process of the fourth lumbar vertebra, this having been clinically suspected of being the right kidney.

The case is reported as congenital diaphragmatic hernia, as patient had no history of injury and the gastro-intestinal disturbances date back to early childhood.

## NON-OPERATIVE TREATMENT OF DISPLACED SEMILUNAR CARTILAGES OF THE KNEE-JOINT

BY DOUGLAS GRAHAM, M.D.

OF BOSTON, MASS.

IT would seem as if Nature had been somewhat negligent of her work in placing in each knee-joint a couple of buffers that are so easily displaced as the semilunar cartilages seem to be in some people. Many of us have doubtless supposed that these cartilages are firmly attached by their under surfaces to the head of the tibia, and this has but deepened the mystery of their displacement. A brief review of their anatomy and physiology will be of advantage.

Situated on the head of the tibia and covering the outer two-thirds of the corresponding articular surfaces, held in place by their attachments in front and behind the spine of the tibia, and further fortified by the coronary ligaments in front, the internal lateral ligaments on the inside, and by the popliteus muscle on the outside, it would seem almost impossible for the semilunar cartilages ever to slip out of place. Concave on their upper surfaces for adaptation to the condyles of the femur so as to facilitate flexion and extension, and lined by synovial membrane, not only above, but, as some recent writers seem to have forgotten with the rest of us, also on their under surfaces as well, in order to permit rotation between them and the head of the tibia, the complexity of this joint is remarkable. Morris' description is particularly good of these cartilages: "They lessen the shock and jar of walking, running, and jumping; they fill in the intervals between the articular surfaces of the femur and tibia, which during extension are slight, but during flexion are considerable; they deepen the facets of the tibia for the condyles, and for this purpose they are less fixed at their fore part than behind, so as to be able to close in upon the spherical portions of the condyles in flexion and to slide forward and be squeezed out into large circles by the anterior, nearly flat portions of the condyles in extension. This adjustment of the fibro-cartilages to the condyles of the femur in the varying positions of the joint is due partly to their own tendency to shift, partly to their connections, and partly to the pressure and pull of surrounding parts. In flexion and extension the cartilages move with the tibia upon the femur. In supination and pronation the tibia moves upon them while they remain unaltered in their position to the femur; the outer cartilage is steadied chiefly by the pressure of the popliteus, the muscle chiefly concerned in rotating the tibia inward or pronating the leg, against the margin of the cartilage while it is acting upon the tibia."<sup>1</sup>

It is difficult to appreciate "the large circles" that the semilunar cartilages are squeezed into by extension, as well as to realize the statement of Dr. Scott

Lang that "in a perfectly sound knee the internal semilunar cartilage can be distinctly felt to recede when the knee is flexed and to come forward in extension on the antero-internal aspect of the joint." Even when all the indications point to displacement of semilunar cartilages, more often than not these cartilages cannot be felt, as in the three following cases, which were evidently due to dislocation of the internal semilunar cartilage:

*Case Reports.*—CASE I.—Male, twenty years old. Two years before, when jumping, he put his right knee out of joint, but kept walking about upon it although it pained him much for several weeks. Twice afterwards he sustained the same injury to it, though less severely, and he had had several "kinks" besides. Three days before being examined he had twisted it as badly as at first, and he was obliged to walk on tiptoe with knee semiflexed. The day after the accident he was told that a cartilage was out, manipulation failed to reduce it. He was discharged with the knee enveloped in cotton batting and a bandage over this, and continued to hobble as before. The pain was referred to the inner aspect of the knee, which was tender on pressure, and any attempt to extend the leg increased the pain. The tissues around the knee seemed relaxed, there was no effusion or swelling, or undue projection of the internal semilunar cartilage. Flexion caused no pain, and while the leg was reflexed I pressed firmly with my thumb over the painful spot and extended the leg quickly, and repeated this a few times, with the result of getting the leg extended. This procedure was somewhat painful, but by allowing him to rest a few minutes while using massage and then repeating the same movements of extension the pain decreased. With the heels of the hands over the natural depressions in front of the knee-joint strong pressure was made while the leg was flexed, it was then extended vigorously. After this, free and gentle passive motion was used and well tolerated. Placing a pad formed by a few folds of bandage over the inner aspect of the knee, a bandage was applied firmly over this and around the knee, and the patient walked off almost naturally with but a slight limp. In standing he could not fully extend the leg. The following day the knee was massaged and gentle passive motion employed, while exerting pressure over the inner aspect of the joint. A splint was applied to the back of the leg and thigh, but discarded as the bandage and pad alone were sufficiently comfortable and supporting. He has apparently had no return of the condition.

CASE II.—Miss A., nineteen years old. Ten months before while running down hill suddenly felt something slip on the inside of her right knee. The pain was momentary and she managed to walk home with difficulty. Two weeks after this it slipped again; the leg was semiflexed and could not be extended. It was kept in a splint for a fortnight and gradually straightened. It seemed well for several days, but soon slipped again while going down stairs, and she did not step with it for four weeks. An orthopædic surgeon was consulted, who put it in a plaster case for three weeks and later in a metallic brace, which she wore only two days. After this another slip, followed by effusion, laid her up for ten days. The swelling soon disappeared. She has had several more slips since then, some of them on slight provocation, as when sitting with the lame leg partly crossed over the other below the knee and allowing it to roll outward by its own weight. She has always distinctly felt something slipping out at the inner aspect of the knee when she has made a misstep or done anything to twist the leg out. Recently she could sometimes feel it slip back. Five weeks before she came to me she stubbed her toe and had a more severe relapse than



usual. She had worn a plaster case almost continually for seven or eight months, removing it occasionally indoors.

On examination I found slight peri-articular thickening on each side of the ligamentum patellæ, but no effusion in the joint. Passively rotating the leg outward caused discomfort on the inside of the knee, but inward rotation did not. Extension was normal; flexion but one-fourth normal, and on attempting to bend it further, pain was produced at the anterior aspect of the internal condyle. No undue projection of the internal semilunar cartilage could be made out. There was an apparent atrophy of disuse of the quadriceps extensor. Exercise to strengthen these muscles was instituted. The whole limb was massaged daily, more especially the muscles of the thigh; faradism was applied to the quadriceps extensor, flexion was gradually increased, while firm pressure was made over the inner aspect of the knee, and after these a bandage was firmly applied around the knee over a pad on the inside. The pad and bandage sufficed to give the leg a feeling of security and allowed more freedom of motion than anything that had been applied. In four days the leg could be bent to a right angle. In order to improve the flexion she was told to support herself and get into a squatting position three or four times a day. To prevent a repetition of her accident she was advised to walk with the knee extended and toes turned out. Two months later she reports having regained practically normal function.

CASE III.—Mr. C. E., fifty-two years old. Three weeks before his right foot caught in a croquet wicket and he hurt his knee. It was semiflexed and painful, and attempts to straighten it were not successful. His physician did it up in plaster-of-Paris for three or four days, and after that he hobbled about with it partly flexed. Slight, unexpected eversion of his foot had often thrown something out at the inside of his right knee, and this had frequently occurred in bed. But he had always been able to twist and extend the leg himself in such a way that he could feel it slip back again, until this last time. The knee had bothered him in this way for ten years.

On examination there were found slight effusion and heat and some peri-articular thickening, and the muscles on the front of the thigh were soft and flabby. No projecting cartilage could be felt. Massage and snug bandaging were given with a pad over the inside of the knee, passive motion with firm pressure over the seat of the internal semilunar cartilage every day for a few days, and later every other day, with home exercises of extension and flexion. In two weeks he had good use of the knee and could go up and down stairs and in two weeks more he had resumed riding his bicycle.

The increased comfort and support of a bandage with a pad under it, in comparison with the discomfort and lack of support of splints and plaster cases, is surprising.

The following case is narrated by Dr. W. H. Bennett:

CASE IV.—A soldier had a displacement of the internal semilunar cartilage which was replaced soon after the injury. The ordinary exercises of the gymnasium were at once prescribed. At the end of a week the displacement recurred, pain was intense, and complete extension impossible. Reduction was attempted, but without success. The exercises were continued and as much walking as possible allowed. Six weeks later the leg was still flexed and could not be extended by manipulation, the knee was distended and pain on walking acute. Rest for a fortnight and massage without exercise removed the fluid, and reduction occurred spontaneously while turning in bed; but recurrent attacks followed until he was operated upon and a piece of the semilunar cartilage removed.

Text-books on surgery are woefully deficient in information concerning displacement of semilunar cartilages. The best monographs on the subject are by Dr. Scott Lang and Dr. Herbert W. Allingham, and from these we learn that the semilunar cartilages may slip forward, backward, inward or outward. The internal semilunar cartilage is the one most often at fault. As to the symptoms in general, the knee is usually semiflexed and can not be extended; but flexion is usually free in recent cases. The foot is turned outward when the internal semilunar cartilage is displaced; inward when it is the external semilunar cartilage. In most cases little or nothing abnormal can be seen or felt about the joint, except the semiflexion and a little tenderness at the head of the tibia. Rarely can the cartilage be felt projecting, and even when it does synovitis may supervene in a few hours and mask it.

*Etiology.*—Though any violent accident may produce internal derangement of the knee-joint, most cases would probably coincide with Doctor Knott's instructive description of his own case: "It has always been the result of a very slight, and in every instance, an indirect violence. This violence has always been applied so as to produce a twist at the knee, either of the leg outward or of the femur inward. The most common cause has been striking the inside of the great toe against something when the knee has been slightly flexed, the parts about the joint as relaxed as possible, and the muscles thrown off their guard. I never suffered any derangement when the limb was in a decided state of active motion."<sup>2</sup>

The whole subject has been still further elucidated by Dr. Scott Lang,<sup>3</sup> who points out that the internal semilunar cartilage is displaced in rotation of the leg outward combined with flexion, and external semilunar cartilage in rotation of the leg inward combined with flexion, and that the injury is caused by some sudden and almost involuntary movement when the muscles governing the joint are off their guard or fail to act in concert with one another. A lax condition of the ligaments and muscles of the knee-joint from general debility or previous synovitis would predispose to these accidents.

*Treatment.*—Laying aside cases that require surgical interference by cutting into the joint, the indications for treatment must be very clear. Restore the cartilage to its natural position if possible. Retain it there. Strengthen the joint and muscles so that they will be less likely to be caught off guard. Various suggestions are made as to the methods to be pursued to replace the semilunar cartilage. When one fails another is tried. The method that seems to be most reliable is as follows: Flex the leg as much as possible upon the thigh, then rotate the tibia inward if the inner cartilage is displaced, outward if the external, and extend the leg quickly upon the thigh while pressing with the thumb where the cartilage is supposed to be out of place. The opposite procedure, extension, then flexion with pressure, sometimes succeeds. As it may be very difficult to ascertain whether a cartilage has slipped out of place or not, Dr. Samuel J. Mixter has made the very shrewd suggestion "that in every case of sprain or twist of the knee, movements of replacing a dislocated meniscus should be ordered;" but if a semi-

lunar cartilage is not displaced, it is very evident that such a procedure would hurt the patient unnecessarily and be very likely to aggravate a sprain of this joint, and if a semilunar cartilage were not displaced, such movements might put it out in a sprained knee.

Concerning this point Dr. William H. Bennett says that repeated futile attempts at replacing the structure which is supposed to be displaced have been the cause of some of the worst cases of traumatic arthritis of the knee-joint with which he has had to deal, and in two led to the development of tuberculous disease. Temporary fixation and massage he considers of the utmost importance for the removal of the fluid from the joint and to allow the loose portion of the cartilage to fall back and adhere in its normal situation, which with the help of the surrounding inflammation often follows to some extent. Massage of the muscles and of the joint without motion can not be begun too soon, for it prevents the wasting of the muscles and the flaccidity of the capsule. Passive motion without rotation should soon follow, as it prevents adhesions; but passive or active motion involving rotation should not be encouraged in the early stages.

It does not seem to me that a hamsplint or a plaster case is so direct and effectual in retaining a semilunar cartilage and supporting the knee as a pad with a snug bandage over all. Moreover, there would seem, in some cases, at least, to be a tendency of these cartilages to slip back into place even when attempts to readjust them had failed, but if the joint is immovably fixed by a hamsplint or plaster case, its power to adapt itself to a return of the cartilage by unconscious motion is prevented, which is not the case with a pad and bandage. For the relief of the heat, pain and swelling that result from a sprain, wrench, or twist, massage properly applied is most satisfactory. For the preservation of the circulation and nutrition of the muscles and the prevention of atrophy, massage applied early has proved to be quite effectual.

As displacements of the semilunar cartilages are most likely to occur when the muscles are off guard, our endeavors should be to strengthen these muscles so that they will not be "caught napping." I imagine that the behavior of muscles in this manner is due in great measure to a loss of muscular sense, the restoration of which is promoted greatly by means of massage, and this will be still further aided by alternating massage with carefully graduated movements of pushing and pulling, and of voluntary efforts of holding the leg extended. A few minutes' application of the faradic current to the quadriceps extensors immediately after the massage sometimes seems to have a more invigorating effect than either alone, and, moreover, the contractions caused by the faradic current are but another and useful form of motion.

Walking with the foot turned inward is considered to be a good precautionary measure when the internal semilunar cartilage is liable to slip out of place, with the foot turned out when the external cartilage is likely to slip, but as either of these positions allows all the more latitude for rotation in the opposite direction when the knee is semiflexed, it can only be safe so long as the patient receives no violence to throw the leg in the opposite

direction; whereas, if the patient walks with the foot turned out and knee extended, where it is a question of preventing dislocation of the internal semilunar cartilage, then, as it is already in the position where the cartilage is liable to be displaced, but with the muscles on guard, unexpected violence is resisted, and the range of motion that would be dangerous is reduced to a minimum, as was the case with the second patient reported.

In cases that have required operation for the removal of the semilunar cartilages or for stitching them in place, the joint is generally stiff for some time afterwards. As soon as two or three weeks after the operation Doctor Allingham recommends daily massage and passive motion, and later that the patient should try to sit on his heels, assisted by holding on to something, so as to graduate and control the weight upon the knee.

Full of significance are the following words of Dr. A. Logan Turner<sup>4</sup>: "In order to gain some idea as to how soon after operation a man may return to his work, one must take into consideration the nature of the operation, the length of time during which splints have been worn, and the amount of care which the patient gives to massage and movement."

It is important to learn that some good surgeons like Dr. A. N. McGregor, of Glasgow, consider that the passive motion and massage in these cases may be commenced on the removal of the sutures at the sixth to the tenth day, or, if much swelling of the joint has occurred, they may be delayed to the fourteenth day.

In about three weeks the patient should be able to walk about with the aid of a stick, and some of his patients have been able to work in six weeks from the date of the operation.<sup>5</sup>

*Conclusions.*—1. That neither in their natural or unnatural position can semilunar cartilages often be distinguished from the surrounding tissues. They seem to form an inseparable part of the head of the tibia.

2. That the position of the leg affords the best means of inferring whether one or the other semilunar cartilage may have been dislocated when it cannot be felt, the leg being usually flexed and the foot turned out when the internal meniscus is dislocated, the leg flexed and the foot turned in when it is the external.

3. To attempt to replace a dislocated semilunar cartilage it is wise to flex the leg, then extend suddenly, rotating the leg inward if it be the internal cartilage, outward if it be the external, while exerting pressure over the offending region.

4. That there is a natural tendency in some cases of dislocated semilunar cartilages to slip back into place when the leg is not artificially restrained.

5. That if the knee be immovably fixed by plaster or splints before the cartilage has got back into its natural situation, the joint is locked and restrained from gentle instinctive movements that might favor its return.

6. That cases of displaced cartilage are attended by voluntary and involuntary restraint of motion on account of pain and mechanical impediment, and in some cases by synovitis and the formation of adhesions. Forcible passive

motion might then have the double purpose of breaking the adhesions and rectifying the displacement.

7. That even after a meniscus has been restored to its natural situation it is not so securely and comfortably held by plaster and splints as by a pad of a few folds of bandage and a figure-of-eight bandage applied over this, which affords support and comfort and a safe limit of motion.

8. That it is possible by carefully applied massage, resistive movements, exercises, and electricity, to so strengthen the muscles on the front of the thigh, the fascia, ligaments, and attachments of the knee-joint, that they will safely hold a previously dislocated semilunar cartilage without artificial support.

9. These remarks do not apply to cases requiring surgical operation, though the above-mentioned combination of treatment might be safely tried in some cases before cutting into a knee-joint, but more especially after operation for restoring motion and strength.

Closely allied in symptoms to unstable semilunar cartilages of the knee-joint are thickened fringes and hypertrophied synovial villi. In a few patients who have recently come to me for treatment and were patiently and hopefully waiting for operation as a last resort, the kinks, the catches, and the synovitis have rapidly disappeared under massage and tight bandaging, and the joints have resumed their normal shape and function. This might be explained by the squeezing of the exudation out of these fringes and pushing them up into the intercondyloid notch where they would not be liable to be pinched between the condyles of the femur and the head of the tibia.

#### REFERENCES

<sup>1</sup> Henry Morris: *Anatomy of Joints*, London.

<sup>2</sup> Doctor Knott: *Dublin Quarterly Review*, 1882, p. 489.

<sup>3</sup> Scott Lang: *Edinburgh Medical Journal*, 1886-87.

<sup>4</sup> A. Logan Turner: *Internal Derangement of the Knee-joint*, *Edinburgh Hospital Reports*, vol. ii, 1894.

<sup>5</sup> A. N. McGregor: *International Clinics*, 1908.

## FRACTURES OF THE FEMUR IN CHILDREN\*

TREATMENT AND END RESULTS IN 268 CASES

By CARL G. BURDICK, M.D.

OF NEW YORK, N. Y.

AND

IRWIN E. SIRIS, M.D.

OF BROOKLYN, N. Y.

FROM THE CHILDREN'S SURGICAL SERVICE, BELLEVUE HOSPITAL, NEW YORK, N. Y.

THIS report comprises cases of fractures of the femur in children up to the age of thirteen years. It incorporates two groups of cases; the first, sixty-seven fractures that were admitted to the service from January, 1916, to July, 1917. The second series of two hundred and one fractures that were admitted from October, 1919, to October, 1922. We have not included

fractures of the femur associated with serious injury to other regions of the body which resulted in death shortly after admission.

The report will emphasize the conservative line of treatment, the course followed and the observations made in the hospital and return clinic.

The majority of cases in which the anatomical approximation of the fracture was not satisfactory have been followed

for a period of six months to three years. The clinical course has shown that perfect anatomical reduction is not essential for perfect functional recovery in children. Marked displacement and over-riding of the fragments will usually result in a good functional limb, without appreciable deformity, tilting of the pelvis or compensatory curvature of the spine. It will also demonstrate that shortening, which existed on discharge from the hospital, was not always permanent, and in a number of cases where shortening existed at the time of discharge subsequently presented an appreciable lengthening within a year or two. This lengthening was frequently present when operative intervention had been resorted to in the reduction of the over-riding fragments. The lengthening was not due to over-correction of the over-riding with the exception of two cases in which calipers were inserted.

The stimulation of the growth of bone in its longitudinal direction occurred in the fractures of the diaphysis irrespective of their location in the shaft; in

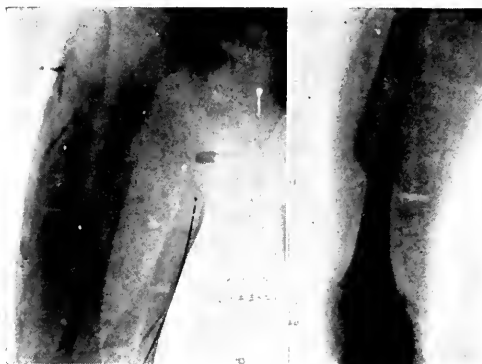


FIG. 1a.—J. F., five years. Oblique fracture, upper third, treated in Bryant's frame. Discharged with  $1\frac{1}{2}$  cm. shortening.

\* Read before the New York Surgical Society, March 14, 1923.

no case was there any involvement of the epiphysis when subsequent lengthening ensued. In the cases of extreme shortening no disability resulted, the shortening being compensated for by slight tilting of the pelvis, which was difficult to detect.

Ashhurst states that "Surgeons often make a mistake in very young children in regarding bones as things separate from soft parts; the bones were originally formed out of soft parts and the younger the patient the more intimate is the physiological connection between the two. The bones depend for their form on the action of the muscles and in the daily use of the limb, almost any deformity of the shaft of a long bone in a young child will be spontaneously corrected within six months or a year."

*Age.*—The youngest was an infant which had sustained a birth fracture and had been transferred from the maternity service on the fifth day. The greater number of fractures occurred during the third, fourth, fifth, sixth, and seventh year. The comparative frequency of fractures in the various ages are enumerated in Table I.



FIG. 1b.—Final result, two and one-half years later, no shortening.

TABLE I

5 days .....	1	3 years .....	27	8 years .....	20
2 months .....	1	4 years .....	26	9 years .....	21
6 months .....	3	5 years .....	39	10 years .....	16
1 year .....	14	6 years .....	35	11 years .....	12
2 years .....	15	7 years .....	33	12 years .....	5
Total .....					268

*Type of Fracture.*—There were two hundred and sixty-one simple fractures and seven compounded.

The most common type of fracture was the oblique, which with the spiral comprised 55 per cent. of all fractured femurs (Fig. 1), 35 per cent. were transverse (Figs. 2 and 3), and 3 per cent. comminuted (Fig. 4), two were pathological, one following an acute osteomyelitis of the femur and the other in a case of achondroplasia.

*Location of Fracture.*—There were only two fractures of the neck of the femur, both caused by direct violence. For the convenience of classification most of the fractures were grouped into upper, middle, and lower third. Sixty-four per cent. occurred in the middle third, 20 per cent. in the upper third and 9 per cent. involved the lower third. There were five supracondylar

and six of the lower epiphysis. Five children sustained fractures of both femurs.

TABLE II

Head .....	0	Lesser trochanter ...	0	Lower third .....	28
Neck .....	2	Upper third .....	56	Supracondylar .....	5
Great trochanter .....	0	Middle third .....	171	Lower epiphysis.....	6
Total .....					268

*Displacements of Fragments.*—The records of the first series of cases were not complete enough to give the displacement of all fragments, consequently the statistics on displacement of fragments are drawn from the second series of two hundred and one fractures.

In fractures of the upper third the upper fragment was displaced internally and posteriorly nearly as frequently as the more commonly accepted displacement of flexion and abduction. In the middle third the more frequent displacement of the upper fragment was internal and anterior, while in the lower third the upper fragment was usually displaced externally. A detailed report of the displacement of both fragments is given in Table III.

TABLE III

	Upper Fragments			Lower Fragments		
	Upper 3rd	Middle 3rd	Lower 3rd	Upper 3rd	Middle 3rd	Lower 3rd
No displacement .....	6	20	5	6	20	5
Posterior .....	2	8	0	7	29	1
Internal .....	10	37	1	9	20	1
External .....	13	31	6	9	24	1
Anterior .....	5	22	1	2	8	0
Inward and backward ...	0	0	0	6	11	3
Outward and anterior ...	3	8	0	0	6	0
Outward and backward...	1	1	0	3	9	1
Inward and anterior.....	4	5	1	2	5	2
No record .....	..	1	..	..	1	..
	44	133	14	44	133	14

SUPRACONDYLAR FRACTURES

	Upper Fragment	Lower Fragment
No displacement .....	3	3
Posterior .....	1	1
Anterior .....	1	1
	5	5

*Treatment.*—The various methods of treatment have been grouped into non-operative and operative as indicated in Table IV.

In the endeavor to make the treatment uniform and readily applicable to as many cases as possible, all the readily available procedures were given a satisfactory trial in standardizing the treatment on the service. It was found that the more simple the apparatus which would not hinder careful observation and nursing, and which served as a permanent appliance from



## FRACTURES OF THE FEMUR IN CHILDREN

the inception of the treatment, was the most desirable, even though a longer time elapsed before functional recovery was obtained.

Irrespective of the method of treatment employed in the reduction and fixation of the fragments, the preliminary procedures pursued were the same and are worthy of mention.

On admission to the dressing room, the nature of the fracture, deformity and shortening are recorded and the limb is fluoroscoped. A towel is placed around the ankle in the form of a loop and a rope is attached from which traction of ten to fifteen pounds is immediately made over the foot of the stretcher. This procedure relieves the patient of considerable pain caused by the fragments pressing against the

soft structures, overcomes muscular spasm, prevents further over-riding and facilitates subsequent reduction.

All fractures of the femur are treated as emergency cases and a member of the Attending Staff is required to be present. Unless some serious trauma to another region of the body contraindicates the administration of an anæsthetic and manipulation, the patient is anæsthetized, and if the fracture is transverse an attempt is made to reduce and lock the fragments. Moleskin or zinc oxide plaster is applied in all cases even if we feel the fragments have been satisfactorily reduced and locked.

Children up to the age of six are then suspended in a Bryant frame (Fig. 5). This form of treatment may be employed for older children, but should not be encouraged, as the great weight of the body will frequently tear off the extension straps, permitting sagging of the fragments and requiring its frequent reapplication.

The type of frame we have adopted consists of two uprights about five feet long slotted in four places to permit the cross-bar and pulleys, fastened

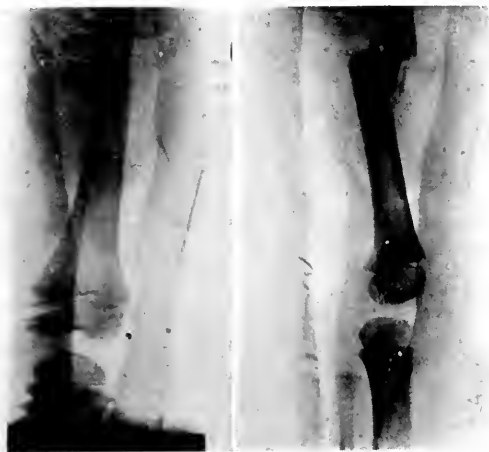


FIG. 2a.—S., four years. Transverse fracture middle third. Treated in Bryant's frame. Discharged with  $\frac{1}{2}$  cm. shortening.



FIG. 2b.—Final result ten months later, no shortening.

to the upper ends of the uprights, to be adjusted to any desired height. A horizontal bar, to which two pulleys are attached, is fastened to the back of the head of the crib. The uprights have been made of sufficient length to permit raising the buttocks for a bedpan or the changing of linen without the feet coming in contact with the suspension bar, which would allow sagging of the extremities.

If it has been possible to lock the fragments or if there is not much over-riding, both legs are suspended with sufficient weights, which exert traction



FIG. 3.—J. McG., nine years. (a) Transverse fracture, junction middle and upper third. Bryant's frame suspension. Two centimetres shortening on discharge. (b) Final result two years later.

through the pulleys at the head of the bed, to keep the buttocks about two inches off the mattress. The moleskin or adhesive has been applied from the top of the thigh as recommended by Groves, who contends that the whole tube of soft parts, skin, muscles and fascia, together with the lower fragment, will be pulled down directly over the upper fragment.

Recently in cases where there is considerable over-riding we have felt that only the fractured limb should be suspended, as we have found by numerous experiments that with only one limb suspended we get 25 to 33.3 per cent. more traction. The patients, however, are more comfortable and the nursing is simplified if both legs are suspended, but if

there is much over-riding enough traction is not exerted to overcome it. The degree of abduction or adduction of the extremities will vary with the line of fracture, the usual position being about thirty degrees abduction. The suspension is discontinued at the end of four weeks, at which time there is no limitation of motion at the ankle and but very slight limitation at the knee. The patient is kept in bed another two weeks and by that time the flexion of the knee is about normal. One of the annoying complications of this form of treatment is the fact that the adhesive extension is apt to slip gradually and unless we are constantly on the watch disagreeable pressure sores have formed over the tendo Achillis and dorsum of the foot.

Our experience leads us to believe that this form of suspension serves only as a means of immobilization and the over-riding of the fragments is not materially changed irrespective of the amount of traction employed.

Various methods of treatment have been used for the immobilization of fractures in older children, but the most satisfactory procedure is the plaster spica with continuous extension (Fig. 6). After reducing the fragments on the Hawley table and having applied the moleskin or zinc oxide plaster traction



FIG. 4a.—S., ten years. Transverse comminuted fracture upper third, in case with extension. 1 cm. shortening on discharge.

straps, the femur is maintained in a position of moderate abduction by means of a plaster spica extending from the malleoli to the ribs, with continuous skin extension, ten to fifteen pounds traction being applied with the foot of the bed elevated. After the plaster spica has hardened, a subsequent radiograph is taken in bed to ascertain if the reduction has been satisfactory. No further treatment will be required until the removal of the cast at the end of six weeks. The results from this method have been so uniformly satisfactory that this procedure has been adopted as a routine. There is no limitation in motion of the hip-joint, the disability at the knee is only temporary, and before another month has elapsed there is a complete range of motion at the knee unless there is some associated condition limiting flexion. Passive and active exercises are instituted and the patient is allowed out of bed in two weeks on a prone board and crutches, the latter being discarded at the end of another two weeks.

The maintenance of continuous skin traction is used not with the idea of improving what over-riding may exist after reduction, but to attempt to prevent any change in the relative position of the fragments.

*Suspension Treatment.*—As indicated in Table IV, several cases were treated by suspension with the Thomas or Hodgen splint, to observe the efficacy of this method in children between seven and twelve years of age. The children would toss about and tilt the splint to the sides, the rings were either too small or too large, occasionally the ring would become moist or the skin



FIG. 4b.—Final result, eight months later no shortening.

traction would slowly slip down over the heel and malleoli, producing a sloughing of the skin unless carefully guarded against. In cases where the knee was flexed and the extension made only on the thigh, the constant wriggling of the patient, who only occasionally coöperated, would frequently tear off the skin traction. This method requires constant vigilance and care, and the advantage claimed, in that active and passive motions are begun at the outset with consequent earlier functional recovery, does not warrant its use as a routine in preference to the plaster case.

There is no advantage of the Hodgen splint over the Thomas splint in children. The latter is recommended for the immobilization of the fracture

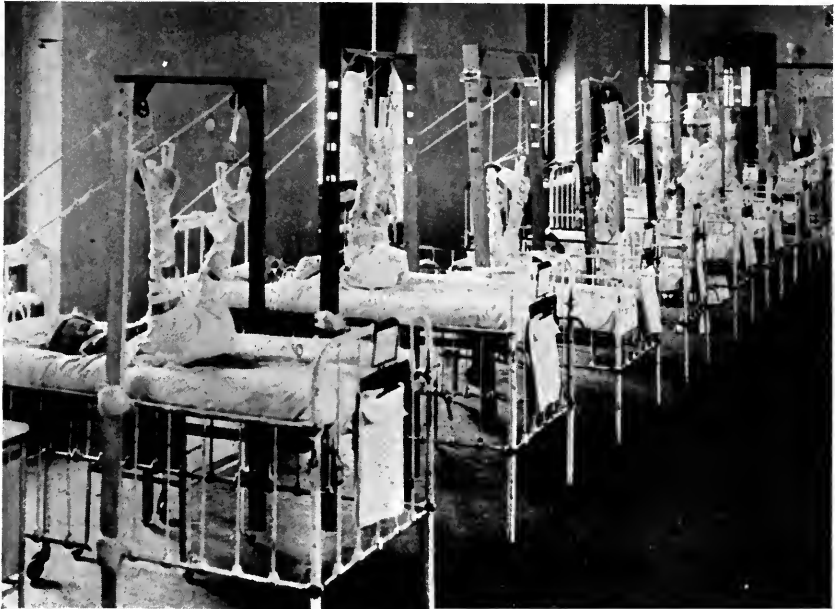


FIG. 5.—Cases in Bryant's frame with suspension.

if the condition of the patient is so serious that an anæsthetic is contra-indicated for the application of a plaster spica, in the majority of compound fractures and cases in which skeletal traction is required.

*Operative Treatment.*—In the first group of sixty-seven cases an open operation was performed in five, a percentage of 7.5 per cent., and in two a Steinman pin was inserted. In three of the open operations Lane plates were used, one was reduced after cutting down on the fragments and in the fifth the fragments were reduced and held in place by kangaroo tendon.

In the second group of two hundred and one cases open operation was resorted to in seven, a percentage of 3.5 per cent. Lane plates were inserted in three patients, three were reduced after cutting down on the fragments, and the seventh an oblique supracondylar fracture was held in position by the insertion of a wood screw. Calipers were used in five cases, four of which were suspended in a Thomas splint (Fig. 7) and one in a Bryant frame.

## FRACTURES OF THE FEMUR IN CHILDREN

Since the adoption of skeletal traction with calipers, we have not resorted to an open operation, and we feel that in children it is rarely if ever indicated. The only indication would seem to be the interposition of muscle or fascia between the fragments, and in our series we have not had a single case in which it occurred.

TABLE IV

### *Treatment*

Non-operative	
Bryant frame and suspension .....	96
Thomas splint and traction .....	14
Hodgen splint and traction .....	2
Plaster spica and traction .....	118
Hamilton side splint and traction .....	2
Operative	
Lane plating .....	6
Open reduction .....	6
Calipers .....	5
Steinman's pin .....	2
<i>Combined Treatment</i>	
Bryant frame and extension following use of Thomas splint.....	1
Plaster spica case and extension following the temporary application of a Thomas splint .....	6
Plaster spica case and extension changed from the Bryant frame.....	5
Plaster spica case and extension following a Hamilton S. S. and extension .....	5
268	

COMPOUND FRACTURES.—There were seven compound fractures, the majority of which were compounded from within. The earlier cases were treated in plaster with a fenestra if necessary to dress the compound wound. Recently the Thomas splint has been adopted as a routine.

### CASE REPORTS

CASE I.—B. B., seven years old; compound fracture, spiral upper third, marked outward displacement of lower fragment. Punctured wound. Case five days after admission. Subsequent X-ray showed outward displacement of lower fragment. Discharged with sinus, which persisted for several months, then child disappeared. Followed two years later, had been to private doctor, who removed sequestrum; now practically well.

CASE II.—A. B., six years old; compound fracture left femur, simple fracture right femur, slight outward displacement of upper fragment, 2.5 cm. shortening. Steinman pin inserted, later plaster spica applied. Right fracture slipped two weeks after application, marked over-riding. Lane plate inserted. Steinman pin removed in three weeks and case applied. Discharged in three months with good motion in knee-joints. Three years later right leg 1 cm. shorter than left.

CASE III.—O. G., nine years old; compound fracture of the middle of shaft of femur with backward displacement of lower fragment. There was 2.5 cm. shortening. Wound on the inner and posterior middle third of thigh. A plaster spica was applied, reinforced with iron bars to permit access to the wound, which was treated by Carrel-Dakin technic. Wound healed and a closed reduction under

ether was undertaken and suspended in a Thomas splint with skin traction below the site of the fracture. On discharge there was no shortening or disability. At the end of three years there was no disability or shortening.

CASE IV.—V. B., nine years old; compound oblique fracture of middle third of right femur with inward displacement of the upper fragment. Small punctured wound of the thigh about five inches below the groin. There was 1 cm. shortening. Tincture of iodine and a plaster spica case applied. The patient made an uneventful recovery. Case removed in six weeks, .5 cm. shortening on discharge, which persisted at the end of six months.

CASE V.—J. S., seven years old; compound fracture, transverse, upper third, in shock. There was a punctured wound one inch in diameter on the external



FIG. 6.—Plaster spica with extension.

surface of the left thigh, Carrel-Dakin technic; 2 cm. shortening, Thomas splint with extension applied. Six weeks later 2 cm. shortening persisted and there was some angulation at the site of fracture. On discharge there was 60 degrees flexion of the knee. After one year the 2 cm. shortening as well as the angulation was still present.

CASE VI.—D. F., five years old; compound fracture of the left femur and simple fracture of the right. Fracture of the base of the skull. Small puncture wound of the left thigh cleaned, iodinated, dry dressings and suspended from a Bryant frame for four weeks. On discharge no disability, no shortening on the left side; right side .5 cm. shortening. One year later no shortening on the left side and .5 cm. on the right, no disability.

CASE VII.—E. G., five years old; supracondylar fracture with no displacement of fragments. Extensive laceration and avulsion of the skin from the upper and outer part of the left leg and knee, exposing the muscles posteriorly. Thomas splint applied and wound Dakinized. (See E. G. cases of disability on discharge not recorded.)

REFRACTURES.—There were four cases of refracture before discharge from the hospital, and none after discharge. Three were transverse and one oblique. In two of the transverse a satisfactory end-to-end reduction had

## FRACTURES OF THE FEMUR IN CHILDREN

been obtained; in the third there was a moderate inward and backward displacement of the lower fragment. Three were treated by a plaster case and extension, one in a Bryant frame. Three occurred in bed and the possibility of falling out of bed should be considered as an etiological factor. The fourth was allowed to walk too early and fell on the forty-seventh day. One was discharged with .5 cm. lengthening which increased to 1.5 cm. at the end of a year, and another was discharged with .5 cm. shortening and at the end of a year the fractured side was 1 cm. longer.

### CASE REPORTS

CASE I.—A. K., six years old; transverse fracture upper third of right femur and a transverse fracture of the lower third of the left femur. Under the fluoro-

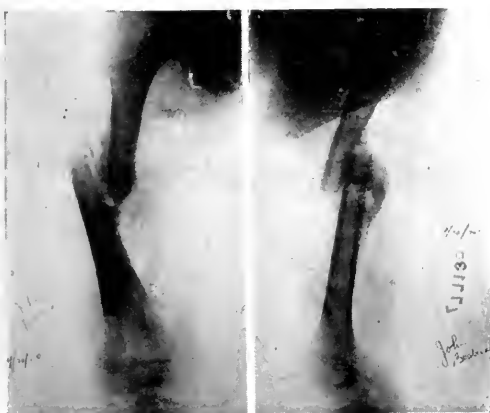


FIG. 7a.—J. B., six years. Old compound fracture, 4 cm. shortening, non-union; attempt made to break up the callus and overcome the shortening with calipers. Twenty-four hours later the old osteomyelitis became acute.



FIG. 7b.—Thigh incised, pus evacuated, ends of bone brought into apposition and held by extension with Sinclair's skate in a Thomas splint.

scope and ether the fragments were approximated and suspended by means of a Bryant frame. (X-ray on the right femur six days after first reduction revealed the fragments in good position.) The suspension was discontinued on the twenty-eighth day. Four days later the patient complained of pain in the upper third of the right femur. There was a refracture at the original site. Under ether and on the Hawley table an attempt was made to correct displacement forward and outward of the lower end of the upper fragment. The cast was kept on for twenty-eight days. On discharge from the hospital there was very slight inward and forward displacement of the upper fragment, very firm union and no shortening. One year later the condition was unchanged.

CASE II.—H. A., nine years old; transverse fracture of the upper third of the right femur; 2.5 cm. initial shortening. Under the fluoroscope and ether the fragments were approximated and the patient placed on a Hawley table while applying the plaster spica extension, which was maintained for six weeks. Two X-rays were taken one week apart and showed the fragments in perfect apposition. There was firm union on removing the case. Two days later complained of pain at the site of the original fracture. He stated he fell out of bed but this is questioned. There was a fracture at the original site. Another case was applied. There was

no shortening on discharge from the hospital nine weeks later. Six months later he left for Honolulu with a perfect functional recovery.

CASE III.—W. C., eleven years old; fracture at the base of the skull and an oblique fracture of the upper third of the left femur, with inward and backward displacement of the lower fragment. The general condition did not permit an anæsthetic on admission. A Thomas splint was applied with skin traction. Six days later on the Hawley table under general anæsthesia a plaster spica and extension was applied. The case was kept on for six weeks with apparently firm union. Five days later refractured in bed. The extremity was again placed in a spica case with extension and was removed in six weeks. The fractured side was .5 cm. longer than the other limb. On returning nine months later there was an excellent functional recovery and the fractured side was 1.5 cm. longer.

CASE IV.—M. S., eight years old; transverse fracture of the middle of the shaft of the left femur, with 2 cm. over-riding. Without an anæsthetic the case

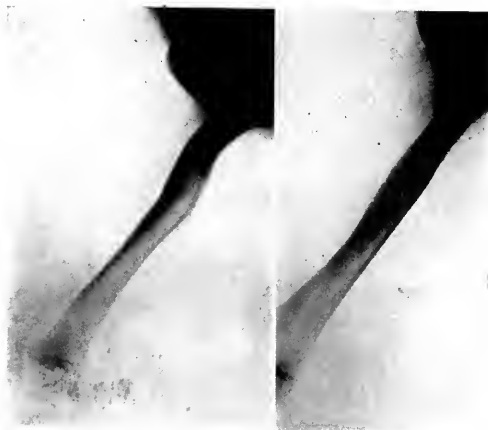


FIG. 7c.—Final result, two years later; no shortening; no evidence of osteomyelitis, perfect functional result.

and extension were applied on a Hawley table. On the twenty-fifth day the case was removed because it was badly soiled and softened. X-ray showed a moderate inward and backward displacement of the lower fragment. On the forty-seventh day the patient slipped while walking and refractured at the same site. Under ether on the Hawley table another plaster spica with skin traction was applied for forty-two days. Home two weeks later with 90 degrees flexion at the knee and .5 cm. shortening. Year later there was a perfect functional recovery and fractured side was 1 cm. longer than other limb.

#### *Disability Due to Lengthening on Discharge from Hospital (five cases).—*

Two cases presented .5 cm. of lengthening on discharge, one of the patients, eleven years old, with an oblique fracture of the upper third was in a case for six weeks and refractured on removal of the case. A second case was applied for another six weeks and at the end of a year 1.5 cm. lengthening existed. The second was a child three years old with an oblique fracture of the middle third of the shaft, which was treated with a Bryant frame. At the end of a year both limbs were the same length.

One case eleven years old presented an oblique fracture of the middle of the shaft with marked over-riding, treated with calipers and twenty-five pounds extension for three days, then ten pounds for thirty days. On discharge there was 1 cm. lengthening, which persisted at the end of five months.

There were two cases in which there was a lengthening of 1.5 cm. on discharge. One was treated in a Thomas splint with caliper extension for thirty-two days. The lengthening has persisted for two years. The other,



## FRACTURES OF THE FEMUR IN CHILDREN

a child of ten years, with an oblique fracture of the middle of the shaft, was treated for ten days in a Thomas splint followed by a plaster case for six weeks. One year later both extremities measured the same.

*Cases Which Presented Subsequent Lengthening.*—There were fifteen cases, on discharge, in which the fractured limb was normal or shorter than the opposite side, which subsequently presented lengthening.

Seven had been treated with plaster case and extension, two in a Bryant frame, three with Lane plates, one with calipers, one was a refracture case which had been treated each time in plaster, and the last was a fracture of the neck which had been treated by the abduction method.



FIG. 8a.—L. C., ten years. Irregular transverse fracture middle third; fracture of the base of the skull, left hæmiplegia and aphasia. Decompression treated with extension in a Hamilton's side splint for twenty-four days; 4 cm. shortening persisting.



FIG. 8b.—General condition improved; Lane plate inserted. Discharged no shortening. (Plate removed nine months later.)



FIG. 8c.—Final result, two and one-half years later, 2 cm. lengthening with anterior bowing.

### CASE REPORTS

CASE I.—L. L., six years old; transverse fracture upper third, treated by plaster spica and extension; discharged .5 cm. shortening. Returned in three years with 1.5 cm. lengthening.

CASE II.—J. F., eleven years old; transverse fracture neck of femur; plaster spica in extreme abduction; discharged, no shortening; returned in three years with 1.5 cm. lengthening.

CASE III.—J. C., ten years old; supracondylar fracture, no displacement, no shortening; plaster spica and extension; returned in three years with 1.5 cm. lengthening.

CASE IV.—W. G., five years old; spiral fracture upper third; treated with Bryant frame; discharged with no shortening; returned in two years with 1 cm. lengthening.

CASE V.—R. L., seven years old; transverse fracture middle third; Bryant frame; discharged with .5 cm. shortening, returned in two years with 1 cm. lengthening.

CASE VI.—S. E., four years old; irregular transverse fracture middle third of femur with sloughing wound of the calf muscles on the same side; treated with

calipers with knee flexed at right angles and suspended from a Bryant frame. No shortening on discharge, returned in one year with 1 cm. lengthening.

CASE VII.—M. G., six years old; oblique fracture middle third, treated with plaster spica and extension, discharged with no shortening; returned in one year with 1 cm. lengthening.

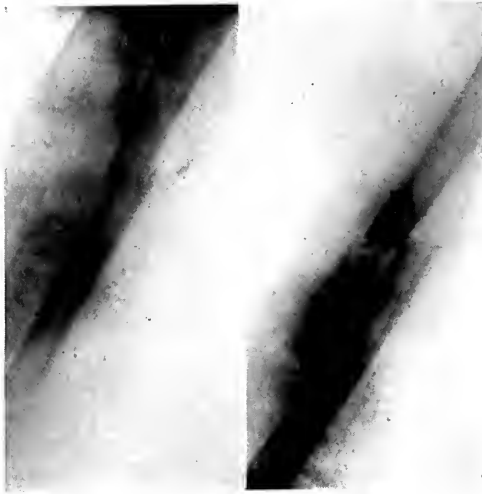


FIG. 9a.—R. B., nine years. Transverse fracture, middle and upper third. In case with extension. One-half centimetre shortening on discharge.

shortening. Returned in two years with 2 cm. lengthening. Plate removed nine months after insertion.

CASE X.—T. D., nine years old; transverse fracture middle third; treated with plaster spica case and extension; discharged with 1 cm. shortening. Returned one year with 2 cm. lengthening.

CASE XI.—D. S., nine years old; irregular transverse fracture upper third; treated with plaster case and extension; discharged no shortening; ends of fragment not in apposition. Returned eighteen months later .5 cm. lengthening.

CASE XII.—M. S., eight years old; irregular transverse fracture middle third. Plaster spica case and extension for twenty-five days (case removed because it was soiled and softened). Refractured on the forty-seventh day in hospital while walking. Case applied for thirty-one days; firm union on discharge; .5 cm. shortening. One year later there was a lengthening of 1 cm. and excellent functional recovery.

CASE XIII.—M. R., six years old; oblique fracture middle third; plaster spica and extension; discharged, no shortening; returned one year with 1.5 cm. lengthening.

CASE VIII.—L. C., ten years old; irregular transverse fracture middle third; fracture base of skull; Hamilton side splint and extension twenty-four days, 4 cm. shortening persisted; open operation, Lane plate inserted, plaster case applied; discharged with no shortening; returned in two years with 2 cm. lengthening (Fig. 8).

CASE IX.—R. W., eight years old; oblique fracture middle third; treated for twenty-one days with Hodgen splint and extension; 3.5 cm. shortening persisted; Lane plate inserted; discharged with no

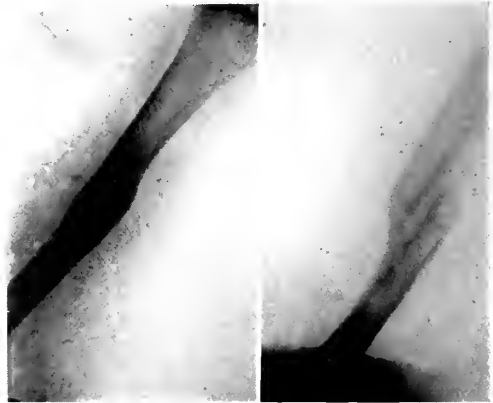


FIG. 9b.—Two months later, fragments having slipped, 1 cm. shortening

## FRACTURES OF THE FEMUR IN CHILDREN

CASE XIV.—J. B., nine years old; transverse fracture upper third; 3 cm. shortening, plated; returned one year later with 1.5 cm. lengthening.

CASE XV.—M. R., six years old; transverse fracture upper third; 2 cm. shortening; case applied; eighteen months later 1 cm. lengthening.

*Disability Due to Shortening on Discharge.*—One hundred and thirty-two cases presented no shortening on discharge, five were discharged in cases, and in eight no mention was made on the history as to shortening.

In sixty-six cases a shortening of .5 cm. existed on discharge. At the end of a year thirty-seven of these showed no shortening, and in fourteen it still persisted. In two cases at the end of two years there was an appreciable lengthening of the fractured limb. In one patient the shortening had increased to 1 cm. at the end of three months, which persisted at the end of one year, due to the fractured ends having slipped, probably because the callus was not sufficiently firm when the child was allowed to bear weight on the limb (Fig. 9). In this case walking calipers would have been indicated. Three cases failed to return to the follow-up clinic. Nine were followed less than a year and during that time showed no change.



FIG. 9c.—Final result ten months after injury: 1 cm. shortening persisting.

There were thirty-four cases in which 1 cm. shortening existed on discharge. At the end of a year eleven were normal, in nine the shortening had diminished to .5 cm. Ten showed no change. At the end of two years one of the above presented no shortening, and in another the fractured side was .5 cm. longer. Three years after injury one patient appeared with 5 cm. shortening. (Fig. 10.) This was a boy of twelve years old, admitted May, 1919, with an oblique supracondylar fracture extending into the epiphysis, with marked inward and backward displacement of the lower fragment. Several attempts at a closed reduction were made without success. An open operation was done and after reduction the fragments were held in position by a wood screw. The patient was discharged with 1 cm. shortening, complete extension and 150 degrees flexion. The following month the screw was removed. Eighteen months later the 1 cm. shortening persisted, flexion complete. Three years later there was 5 cm. shortening and a radiograph showed a premature ossification of the lower femoral epiphysis on the fractured side as the cause of the increased shortening.

Three cases were followed less than a year without any change.

There were ten cases with 1.5 cm. shortening on discharge. At the end

of one year there was no shortening in two cases, in three there was .5 cm. shortening, one of which was normal at the end of two years and in another case 1 cm. shortening. In four the shortening persisted at the end of one year.

There were five cases presenting 2 cm. shortening on discharge; two of these patients moved to other states and were not followed. Of the three followed, one showed only .5 cm. shortening at the end of one year, the second showed 1.5 cm. shortening, and in the third the 2 cm. shortening persisted.

Two patients had 2.5 cm. shortening. At the end of one year one had 1 cm. shortening and the other 1.5 cm. shortening.

FIG. 10a.—B. F., thirteen years. Supracondylar fracture extending into the epiphysis with inward and posterior displacement of the upper fragment. Several unsuccessful attempts made at closed reduction.

There was one case in which 3 cm. shortening existed on discharge from the hospital. This was a child eleven years old who was a spastic paralytic and had never walked. Her condition was such as to contraindicate an anæsthetic and she was treated in a Hodgen splint with extension.

*Summary.*—Of the one hundred and eighteen cases presenting shortening on discharge from the hospital, fifty-three became normal within a period of one to three years, in fourteen the shortening was diminishing, forty-one showed no change, but the majority of these were followed for less than one year, two showed an increasing shortening and five could not be followed.

*Disability Due to Causes Other Than Shortening and Lengthening of Two Hundred and One Cases of the Second Series.*—Records of the first

group were not sufficiently complete to tabulate. One hundred and four cases had no other disability on discharge.

In twenty-seven cases there was a limitation of flexion of the knee within the range of 110 to 155 degrees. At the end of three months there was no disability in twenty-five of these cases. In one flexion was still limited to 110 degrees. This was a child with rickets and at the end of a year the

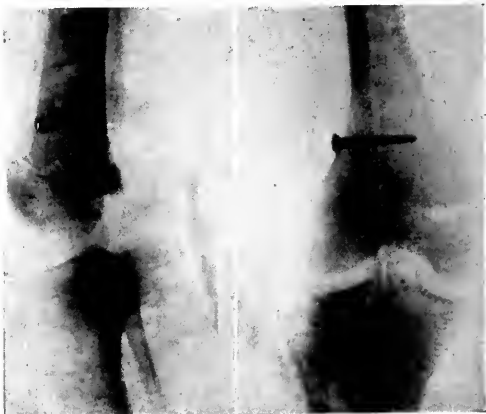


FIG. 10b.—Open operation. Fragments held in position with wood screw. Discharged with 1 cm. shortening.

disability had disappeared. In the other case there was a suppurative process in the region of the knee which persisted for over three months and then became normal.

In thirty-one cases flexion of the knee was limited to ninety degrees. This disability had entirely disappeared in all these cases at the end of three months.

In twenty cases the flexion of the knee was less than ninety degrees. Sixteen of these had complete functional recovery within three months. Two failed to return. One had ninety degrees flexion at the end of three months and within a year there was a complete return of function, this disability was due to an accompanying osteomyelitis of the fibula on the same side, which was present on admission. The last case of this group had 110 degrees flexion at the end of three months and complete functional recovery at the end of a year. This was a re-fracture case and was kept in plaster twelve weeks.

There were three cases of outward rotation. In none was it more than twenty degrees. At the end of one year it had disappeared in two cases and in the third it persisted. This was a boy seven years old with an oblique fracture of the upper third. He had tuberculosis of the spine.

There was one case of bowing at the site of fracture which persisted for two years, a Lane plate had been inserted and subsequently removed and the limb showed 2 cm. lengthening.

There were five cases of angulation at the site of fracture on discharge. One failed to return, one had corrected itself at the end of three months, two at the end of a year, and in the fifth the angulation was still present. This was a compound fracture which was discharged with 2 cm. shortening which also persisted at the end of one year.

Two cases showed a talipes equinus deformity. The first was associated with a sloughing wound of the calf muscles on the same side. Subsequently the tendo Achillis was lengthened and at the end of a year the function was restored. The other had an accompanying osteomyelitis of the fibula, which was present on admission. At the end of a year the talipes had entirely disappeared.

Five patients were discharged in casts and in three there was no record on the history of any disability on discharge.

End results of the five cases discharged in plaster cases:



FIG. 10c.—Final result three years later, 5 cm. shortening caused by premature ossification of the epiphysis.

## BURDICK AND SIRIS

### CASE REPORTS

CASE I.—I. M., ten years old; fracture of the neck of the left femur, put in plaster spica in abduction and slight inward rotation, home at own risk on seventh day, case removed by family physician at seventh week. When seen at home by Social Worker, boy limped slightly, but walked without much disability. Refuses to return to follow up clinic.

CASE II.—M. K., four years old; supracondylar fracture of femur, plaster spica. Home at own risk on third day, case removed in six weeks. Original shortening .5 cm. Returned in three months and one year with no shortening or disability.

CASE III.—J. C., ten years old; transverse supracondylar fracture with no displacement of fragments, plaster spica. Home on sixth day, case removed at clinic at end of sixth week. At end of one year no disability or shortening. At end of two years there was 1.5 cm. lengthening.

CASE IV.—M. S., one year old; incomplete fracture of lower third of femur, light cast, home second day at own risk. At end of year no disability or shortening.

CASE V.—I. D., one year old; oblique fracture of middle third, plaster case. At end of three months no disability or shortening.

End results of the three cases in which no disability was recorded at the time of discharge from the hospital.

### CASE REPORTS

CASE I.—E. G., five years old; admitted with compound fracture of the skull, fracture of right humerus, lacerations about right knee, and a supracondylar fracture with no displacement of fragments, treated in Thomas splint. Lacerated wound became infected and was Dakinized. Developed measles and transferred to isolation ward. Five months later returned to hospital with contracture of knee in position of 140 degrees extension. There was forty degrees flexion.

CASE II.—J. S., six years old; multiple contusions and transverse fracture of middle of shaft, no shortening. Plaster case. No shortening or disability at the end of five months.

CASE III.—J. Y., two years old; transverse fracture of middle of shaft, Bryant frame, home on the third day and treated there in Bryant frame. Returned in three months with no disability or shortening.

*Summary.*—At the end of one year the ninety-eight cases presenting limitation of flexion had a full range of motion.

Of the three cases of outward rotation two were apparently normal at the end of this period.

Only one of the five cases of angulation persisted at the end of one year, and the two cases with talipes equinus deformity on discharge were corrected at the end of one year.

### CONCLUSIONS

Fractures of the femur in children are almost invariably followed by a good functional result. A satisfactory anatomical reduction is not essential for perfect function.

In our experience children up to the age of six are best treated in a Bryant frame. Over six, plaster spica with traction.

## FRACTURES OF THE FEMUR IN CHILDREN

Suspension treatment in a Hodgen or Thomas splint is not practicable except in compound fractures, simple fractures with laceration, or severe trauma to adjacent tissues, where the administration of an anæsthetic is contraindicated and when skeletal traction is to be employed.

The majority of cases which are discharged with shortening will be spontaneously corrected within one to two years.

A certain number of cases irrespective of the form of treatment will be followed by a lengthening of the fractured side.

An open reduction is rarely indicated, as skeletal traction will almost invariably correct any marked deformity.

TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY  
AND OF THE  
PHILADELPHIA ACADEMY OF SURGERY

*Joint Meeting Held January 24, 1923*

DR. JOHN A. HARTWELL, in the Chair

PERFORATED DUODENAL ULCER AND BLEEDING JEJUNAL ULCER

DR. JOHN DOUGLAS presented a young man, twenty-three years old, who had had an acute perforation of a duodenal ulcer, July 19, 1921. He was operated on eight hours after perforation. A large indurated ulcer, situated just distal to the pylorus, had perforated. Because of the extensive induration and œdema, excision of the ulcer could not be done and closure of the perforation seemed to obstruct the pylorus to such a degree that a gastrojejunostomy was performed, a procedure which he usually does not follow in the presence of acute perforation. His convalescence was interrupted by the development of a large subdiaphragmatic abscess in the right side which was drained by resection of the tenth rib under local anæsthesia.

On February 10, 1922, seven months after operation, he had a large hemorrhage from the bowel, and again on September 10, 1922, a large hæmatemesis, followed by several tarry stools, causing marked anæmia. Radiographic examination at this time showed nothing diagnostic. October 31, seven weeks later, he had another large hemorrhage from the stomach which was repeated the same evening, reducing his red blood cells to 1,900,000 and his hæmoglobin to 30 per cent. After three direct blood transfusions during the next two weeks, it was decided to again operate on him as his stools continued to show the presence of blood. It could not be decided at this time whether the blood was coming from his old unhealed ulcer, a new ulcer or a jejunal or gastrojejunal ulcer, although he at no time had complained of the severe pain which is usually associated with the latter lesions. His only subjective symptoms other than the hemorrhages were occasional gastric discomfort and gas pains in the left side of the abdomen and a severe attack of diarrhœa a week before his last hemorrhage.

At operation on November 18, 1922, it was rather surprising to find very few adhesions about the pyloric region, notwithstanding the local peritonitis, following the perforation, and the subdiaphragmatic abscess. The old ulcer showed a very small smooth scar, with no thickening about it or the pylorus. Just distal to the site of the gastrojejunostomy was an indurated area in the jejunum. While holding up the jejunum in order to separate the intestine and stomach at the point of anastomosis



754<sup>a</sup>-

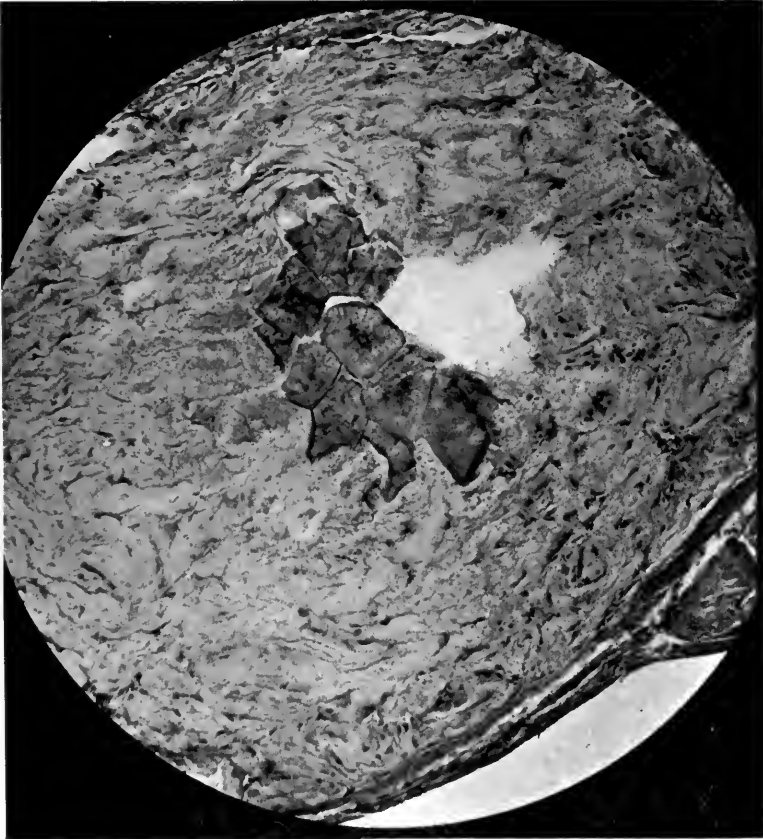


FIG. 1.—Section from nodule on serosa of stomach showing "stone cells."



## PERFORATED DUODENAL ULCER

this area tore through, revealing an ulcer, evidently at the point of perforation. This ulcer was not marginal, as the continuity of the gastric and intestinal mucosa was flawless at all points along the edge of the stoma. No non-absorbable suture material had been used in the anastomosis. The stomach and jejunum were separated and the wounds in each closed with chromic catgut and the abdominal wound closed without drainage. Recovery was uneventful and the patient has been free of symptoms and has gained twenty pounds since his operation. Radiographic examinations, however, during the past few days, show that he has a considerable degree of six-hour retention. The patient is presented because of the early development of the jejunal ulcer, and the severe massive hemorrhages occurring therefrom, although he suffered from very little of the pain which is usually a prominent symptom in the presence of this lesion.

## PERFORATED DUODENAL ULCER

DR. JOHN DOUGLAS also recited the history of a patient eighty-one years old, first seen on October 24, 1922. His gastric symptoms dated back only three or four months, during which time he had suffered from pain and discomfort after eating, loss of flesh and strength and increasingly frequent vomiting. Careful questioning elicited no previous history of stomach symptoms. Radiographic examination demonstrated an advanced degree of pyloric stenosis with a large twenty-four-hour retention. There was no defect in the stomach outline indicating carcinoma and examination of the gastric contents showed normal total acidity and free HCl. It was therefore believed, notwithstanding his age, that he had a benign stenosis, and as his blood-pressure, blood sugar and blood urea and kidney function tests were all remarkably good for a man of his age, operation was advised. He was operated on under local novocaine anaesthesia on November 15, 1922.

At operation the pylorus and first portion of the duodenum were found buried in dense adhesions which could not be separated or satisfactorily explored under the local anaesthesia, but no mass could be felt anywhere in the stomach, nor were the regional glands enlarged. On the anterior wall of the pyloric end of the stomach were two small white nodules about the size of the head of a pin, attached to the serous layer of the stomach wall. These had the appearance of and were believed to be carcinomatous implants, secondary to some primary growth, and were removed for diagnosis. A gastrojejunostomy was then done.

The pathological report from these specimens received was "vegetable cells in the serosa of the stomach," and Dr. F. C. Wood, the pathologist, informed me that these cells were the so-called "stone cells" (Fig. 1.) which occur in the pulp of pears and some other fruits and could only have reached their present location as a result of a perforation of the stomach or duodenum. The following day it was learned from the patient that two years previously during the summer, he had suffered from a severe attack of abdominal pain most marked in the right hypochondrium. This pain was so severe that he had fallen

to the ground and been unable to get up. He received morphine, was kept in bed for about two weeks, and then entirely recovered, having no stomach symptoms until two years later when his pyloric stenosis developed. It is therefore quite evident that he had an acute perforation from which he recovered without operation at the age of seventy-nine years. The patient is shown because of his recovery from an acute perforation without operation at the age of seventy-nine, the occurrence of a benign stenosis of the pylorus at the age of eighty-one and the curious manner in which the diagnosis of perforation was made.

#### PERFORATED DUODENAL ULCER IN A CHILD

DR. WILLIAM A. DOWNES presented G. J., aged three. Admitted to St. Luke's Hospital on December 28, 1922. Discharged January 19, 1923. Diagnosis: Acute perforated duodenal ulcer. Chief complaint: Vomiting and pain in abdomen. Present illness: Began six days ago with vomiting. Vomitus at first contained food, and later became bile-stained. There was no temperature or pain. All food by mouth was stopped and was given nothing but water. On the fourth day was put on small quantities of barley water. Vomiting ceased and child seemed to be better. About ten o'clock on the morning of the sixth day complained of a sudden severe pain in the upper abdomen and immediately vomited a large quantity of brownish material. Vomiting and pain continued during the day, and there was a gradual rise in temperature. A blood count showed 12,000 leucocytes, and a polymorphonuclear count of 82 per cent. The case was considered a surgical one with a probable diagnosis of acute appendicitis.

Upon admission to the hospital at eight P.M., December 28, temperature had risen to 102. There was slight rigidity over the entire abdomen with moderate distention in the epigastric region. An indefinite resistance could be felt to the right and above the umbilicus, giving the impression of an enlarged liver. A blood count showed leucocytes 20,000, polymorphonuclears 92 per cent. In view of the rapid change in the blood count, increasing temperature and the indefinite mass in the upper right quadrant, an exploratory operation was decided upon. Provisional diagnosis: Acute appendicitis with the appendix situated high up under the liver. Mid-rectus incision: Immediately upon opening the abdomen a large quantity of bile-stained fluid escaped. The gall-bladder was found distended and upon exposing the duodenum a perforation about one-eighth of an inch in diameter was found on the anterior surface just distal to the pylorus. There were no adhesions about the perforation and a bloody fluid could be seen escaping from the opening. Perforation was closed by purse-string suture of fine chromic catgut reinforced by several interrupted sutures. All fluid aspirated from the abdominal cavity and wound closed without drainage. Convalescence uninterrupted. Child was discharged from the hospital on the twenty-first day post-operative. X-ray examination made on the seventeenth day after operation showed the stomach to be functioning normally.

## PERFORATED DUODENAL ULCER IN A CHILD

DR. JOHN GIBBON remarked that in a large perforation closed with difficulty and where an omental graft is unsatisfactory, or where infolding of the ulcer results in obstruction, the artificial stoma is indicated. However, if one has observed many perforations from typhoid, one realizes that the obstruction from infolding is more apparent than real as shown at autopsy or at operation for a second perforation. In the case operated upon within a few hours after perforation, it is a question whether gastro-enterostomy should be done. There is a type in which it should not be done and that is where the patient is very ill and where prolongation of the operation adds greatly to the risk. One of the interesting features of this question is what happens to the ulcer after simple closure without gastro-enterostomy. He had had occasion to operate upon three patients in whom a simple closure at the first operation was done. The interval between operations in these cases, sixteen months, nine years, and fifteen years. Each was apparently well after the second operation. Without a gastrojejunostomy, nearly all of these cases will get well and have no further trouble. Fourteen years ago the speaker, in conjunction with Doctor Stewart, reported (*J. A. M. A.*, March 6, 1909) twenty-two cases of perforation on which they had operated, and every case operated on within eighteen hours got well, and every case operated on after eighteen hours, with one exception, died. In late cases it would seem more advisable not to do a gastrojejunostomy.

DR. GEORGE P. MULLER thought that the tendency at the present time in the non-perforative cases was to excise the ulcer with or without gastro-enterostomy; if one was able to operate early in a simple perforation then one could practice such excision and not do a gastrojejunostomy. All writers agree that those cases seen after thirty-six hours will die and yet we teach that they are the ones in which we simply should open the abdomen and establish drainage; the stomach has no chance to empty against the advanced infiltration and œdema, so we ought to be more radical in these cases and by doing gastrojejunostomy perhaps reduce the one hundred per cent. mortality. The speaker recalled a case which resembled the first case of Doctor Douglas. A physician who was operated on in 1914 for perforated ulcer and on August 22, 1922, had a severe hemorrhage. He was given rest and cold treatment, but had another hemorrhage, and after transfusion the stomach and jejunum were opened, but no ulcer could be found. The gastrotomy was closed and the patient entirely recovered.

DR. EUGENE H. POOL said that it seemed to be in the minds of some surgeons that if gastrojejunostomy could be done in conjunction with closure of the perforation, it would insure a permanent cure and prevent future symptoms. It is true that a gastro-enterostomy will prevent symptoms from subsequent pyloric obstruction; but, on the other hand, it will add an appreciable risk, first, of marginal ulcer (2 per cent.), second, a real risk of discomfort and functional distress (about 25 per cent.), which attends all gastro-enterostomies. Therefore, the policy at the initial operation should be

to avoid a gastro-enterostomy, if possible, rather than to do a gastro-enterostomy, if possible. Gastro-enterostomy should be reserved for those conditions mentioned by Doctor Gibbon. When no gastro-enterostomy is done the patient should be carefully watched and a gastro-enterostomy made when and if indicated. Deferred gastro-enterostomy is apparently necessary in about 33 per cent. of the cases.

DOCTOR DOUGLAS, in closing the discussion, explained that the reason he had done a gastro-enterostomy in this patient was because he was certain that he had closed the pylorus to such an extent that pyloric obstruction would result. He thought that in most of these perforated ulcer cases the patients were better off without gastro-enterostomy and agreed with Doctor Gibbon that this procedure was rarely necessary.

#### HYPERNEPHROMA OF OVARY IN CHILD

DR. WILLIAM A. DOWNES presented a second case. T. B., aged three and a half years. Admitted to St. Luke's Hospital on May 4, 1922. Discharged May 20, 1922. Diagnosis: Hypernephroma of the right ovary. Chief complaint: Pain and abdominal distention. Present illness: Began about ten days ago, at which time child complained of sudden severe pain in the lower abdomen. This pain lasted about one-half hour. A few days later complained of a similar attack of pain, lasting about same time. Mother then noticed rapid increase in the size of the abdomen, although she thinks there had been some distention for the past year. On the day of admission to the hospital, child had a temperature for the first time which was later explained by the fact that measles developed two days after the operation. Mother states that the patient has always been considered precocious, acting and talking like a much older child. An unusual development of the external genitals with the appearance of pubic hair was noted some months before the onset of the present symptoms. General health always good. Physical examination showed a well-developed and well-nourished child. Head, neck, thorax and extremities normal. Abdomen much distended, apparently containing a large amount of free fluid. A freely movable mass about the size of a baseball can be felt to the right and below the umbilicus. No tenderness, no rigidity. Provisional diagnosis: Tubercular peritonitis.

Operation, May 5, 1922.—Lower right rectus incision. Immediate escape of a large quantity of straw-colored fluid. The tumor which had been palpated was found to arise from the right ovary and measured about 14 x 12 x 12 cm. The peritoneal covering was congested and the pedicle gave the appearance of having been recently twisted. Left tube and ovary normal. There was no evidence of metastasis in the parietal or visceral peritoneum. The pedicle which was about 3 cm. in width ligated with No. 1 gut. Wound closed in usual way. Convalescence complicated by measles. Discharged from hospital on the sixteenth day. Condition of child at the present time excellent.

Pathological Report.—Diagnosis, hypernephroma of ovary. Tube

## HYPERNEPHROMA OF OVARY IN CHILD

normal. Macroscopical examination: Specimen consists of a tumor of the right ovary with tube attached. The surface of the ovary is smooth and shining and shows minute cysts as well as diffuse congestion of the underlying mass. It measures 14 x 12 x 12 cm., is semi-fluctuating, at one end soft, but at the other cellular. On section there are several broken-down areas at the cystic end, the cavities being filled with bloody serous fluid. About half the mass is yellow, opaque, and consists of rounded tumor masses and a slight amount of hemorrhagic stroma. The growth has no capsule aside from the ovarian wall. The tube is normal. Microscopical examination: Section of the tumor shows a very cellular growth in which there are numerous areas of necrosis. No ovarian tissue appears in the sections, but a very delicate stroma supports the diffuse growth of large cells which are arranged in the form of small alveoli without lumen. For the most part, in the better preserved portions of the tissue, the cytoplasm is either clear or granular, but the cell walls are uniformly well defined and the nuclei small, comparatively regular and stain deeply. Occasionally multinucleated cells are found, but these are usually in the more degenerated portions and suggest involution structures. The growth is extremely vascular and contains large numbers of sinuses with only a single endothelial support. The growth as a whole strikingly resembles tumors of the adrenal cortex, and it is probable that the chromaffin cell furnished an origin for it. Carmine stains show scattered but fairly numerous granules of collagen within the cells.

DR. JOHN SPEESE alluded to a case which came under his observation a few weeks ago. The child, an hermaphrodite, nine days old, was admitted to the Children's Hospital with symptoms of congenital pyloric obstruction, for which an exploration was done. The operation revealed a pylorus somewhat thickened and spastic, the characteristic tumor of congenital hypertrophy was not present. Having in mind the possibility of an early stage of such an hypertrophy, the serosa was divided over the thickened area. The vomiting which had persisted from birth was relieved for several days and there was a slight gain in weight. A recurrence of vomiting occurred, however, which was uncontrollable, and death resulted one week after operation. The autopsy revealed a patulous pylorus; bilateral hyperplasia of the adrenals, the right one, adherent to the surrounding tissues, was the size of the kidney, and was the tumor felt before operation and erroneously diagnosed as pyloric hypertrophy.

From the clinical point of view the case was regarded as spasm of the pylorus and in view of the autopsy findings the condition seems of some importance. The connection of adrenal hyperplasia and hermaphroditism has been established. The relationship between adrenal disease and such a gastric neurosis is of interest, particularly in respect to the experimental work of Friedman, who some years ago endeavored to show a relationship between the development of gastric ulcer and disturbances in the ductless glands. He found that spastic conditions of the stomach musculature were caused by

deficiency in parathyroid or epinephrin secretions, or by excesses of one or more of the thyroid products. If a true diminution in secretion of the adrenals followed disease of the gland in the case mentioned, it is interesting to speculate as to the possible value of the administration of adrenal gland extract in cases of this type.

DR. WALTON MARTIN said that in regard to the explanation of the increase in pubic hair growth, the stimulation of the ovary, due to the presence of the growth, would cause this, and referred to the case of a child of five with tumor of the ovary, and of a boy of seven with tumor of the testicle, in both of whom this phenomenon had occurred, to disappear on removal of the growth.

DR. HOWARD LILIENTHAL did not believe the hair-growing symptom to be entirely a sex matter, but that it was connected with some disturbance of the adrenal secretion. It is on record that hypernephroma has stimulated the unusual growth of hair and this coming on suddenly is one of the diagnostic points of the presence of hypernephroma.

#### SEPSIS FOLLOWING TONSILLECTOMY

DR. EDWARD W. PETERSON showed a child, Martin G., four years of age, who had had his adenoids and tonsils removed by another operator previous to being seen by the speaker. The patient was allowed to go home on the day following the operation and that night was found to have a temperature of  $104^{\circ}$ . There was swelling at the angle of the jaw on both sides of the neck. When examined he had a temperature of  $105^{\circ}$ , was apathetic, somnolent, and decidedly septic looking. The general examination was negative except for a dirty looking membrane in the tonsillar spaces and a suppurative cervical adenitis, just below the angle of the jaw on the right side. Incision and drainage of this abscess made no impression on the general condition. For the first ten days his temperature was constantly high, ranging from  $102^{\circ}$  to  $106^{\circ}$  F., then it became intermittent and ranged from  $97^{\circ}$  to almost  $107^{\circ}$ . For forty-seven days he had more or less fever.

While in the beginning the patient was apathetic, somnolent, and wished to be left undisturbed, later he was extremely hyperæsthetic, wakeful, fretful, and cried a great deal. Several times he had severe chills. He lost weight and strength gradually and showed a moderate, secondary anæmia. Blood cultures were negative. When the sepsis reached a subacute stage a transfusion of 320 c.c. of unmodified blood was given into the left external jugular vein by puncture, by the syringe cannula method. There was a decided fall in temperature, gain in appetite and in strength and improvement in the boy's general condition. This lasted for several days, when the temperature began to rise again. There developed at this time a hard swelling in the left parotid region which gradually increased, until the left eye was closed. Later fluctuation could be detected just above and in front of the left external auditory meatus. Incision into this mass revealed a periostitis of the mandible on the left side just below the articulation. Another



## SEPSIS FOLLOWING TONSILLECTOMY

transfusion was given at this time. Following the drainage of this focus of infection and the blood transfusion the temperature dropped to normal and convalescence was rapid and complete.

DR. W. E. LEE said he had recently had a patient who, after very careful matching with a number of donors, was transfused by the citrate method with 500 c.c. of blood without any immediate reaction. One-half hour afterward, however, he developed a typical anaphylactic protein reaction with high fever, spasm of the unstriated muscles, asthmatic symptoms in the lungs with involuntary voiding of urine and several bowel movements. This subsided after one hour, but the man developed acute oedema of the lungs and died eight hours after the transfusion. During the reaction the urine was examined and no hæmoglobin found. The blood showed no hæmolysis or agglutination.

DR. GEORGE P. MULLER referred to a case he had under his care on whom a tonsillectomy had been done under local anæsthesia. One week later a swelling appeared on the left side of the neck, which subsided, followed by swelling on the right side of the neck, for which he was admitted to the hospital. He was very ill with a temperature 103°. An incision was made in the neck and an abscess found beneath the jaw and extending under the sterno-cleidomastoid muscle towards the posterior triangle. A counter-incision was made and Carrel-Dakin irrigation used. The colon bacillus and staphylococcus aureus were cultured from the pus. Four days later a second collection made its appearance at the lower end of the scapula, and three days after this a third collection appeared over the crest of the ilium. Both were drained. He was discharged, but two weeks later the left side of the neck became swollen and he was readmitted apparently very ill. While walking to the ward the man dropped dead. No autopsy was obtained. Regarding the use of blood transfusion in chronic septic cases, he has had remarkable results in many.

DOCTOR PETERSON, in closing, said that he had had one transfusion experience similar to that of Doctor Lee. A woman with an extreme degree of anæmia, having only 740,000 red cells, a leucopenia and a hæmoglobin of only 10 per cent. Preliminary blood compatibility tests were made and found satisfactory. The transfusion was started by the syringe-cannula method. With the injection of the first syringe of blood the patient stated that she was dying, became restless and hysterical. The lips and eyelids became rapidly swollen and a giant urticaria came out all over the body. The transfusion was stopped at once and for the next twelve hours the patient was critically ill with temperature, delirium, and showed every evidence of a severe anaphylactic shock. She recovered and later several transfusions were given without any anaphylactic reaction, and with great improvement in the anæmia.

With regard to transfusion, Doctor Peterson believed that the procedure did no good during the acute stage of a sepsis, but that in the subacute or

chronic stage, blood transfusions did good through their strengthening and stimulating influence, rather than through any special bactericidal or anti-toxic properties.

#### BILATERAL, MULTIPLE KIDNEY ABSCESESSES

DR. EDWIN BEER presented the following case: J. L., male, twenty-two years old. Admitted Mt. Sinai Hospital, May 16, 1922. Discharged June 23, 1922. The patient was well until ten weeks before admission, when he had a mild infection of the toe. Two weeks later he developed an infection of the right index finger, and two weeks later he developed a cold in the head, and while in bed an abscess of the scalp. At this time he had a temperature for two to three days. Seventeen days prior to admission, he developed some pain in the left lumbar region with fever of irregular character, and was confined to bed. Since then he has had pain in the left lumbar region and tenderness, irregular temperature, no chills, and no urinary symptoms.

His physical examination showed a very pale, septic looking patient. His general physical condition was negative, but in the left lumbar region there was a marked tenderness but no mass to be felt. His blood count showed 29,600 white cells with 86 per cent. polymorphonuclears. His urinalysis showed a trace of albumen, some casts, and a few white blood-cells. Pre-operative X-ray of the genito-urinary tract was not satisfactory, but showed no stone. Pre-operative diagnosis was cortical abscess of the left kidney with possibly perinephric abscess.

On May 16, 1922, under gas, a left lumbar kidney incision was made and a perinephric abscess encountered. The thickened capsule of the kidney was turned back and multiple cortical abscesses were incised without delivering the kidney. The capsule was much thickened and oedematous. In one place the cortical abscesses were so grouped as to suggest a suppurating infarct or carbuncle. Rubber dam was placed in front and another behind the kidney and a tube between the two sheets of rubber. The wound was left wide open. The culture of the abscesses showed staphylococcus aureus. From May 17 to May 23 the wound was irrigated daily and the kidney regularly palpated in the wound and several soft suppurating areas in the cortex were broken up with the finger. During this period the temperature gradually diminished and the patient seemed to be convalescing, when suddenly on the 23rd his temperature rose to 105°. The wound was then explored with the finger and considerable pus evacuated, the kidney being easily palpated in the bottom of the wound. There was some urinary leakage from the kidney into the dressing. May 24, the next day, the temperature dropped to normal and it seemed as if the previous day's digital exploration had controlled the situation. Throughout this period the urine was clear, showing a trace of albumen, a few casts, and occasionally a few pus cells.

May 25 to 26 the temperature again arose. Blood culture was negative and tenderness was recognized in the right lumbar region. May 27 the temperature rose to 103.8° and in the right lumbar region on

## BILATERAL, MULTIPLE KIDNEY ABSCESES

deep pressure tenderness somewhat more marked. Exploration with the finger of the left lumbar wound gave no explanation for the rise in temperature, and on May 29 it was decided that the patient, whose right kidney area was tender, probably had cortical abscesses in the right kidney with some perinephritis. On that day, a right lumbar incision was made and the lower pole of the right kidney was found necrotic and surrounded with thick green pus; perinephric tissues were thickened and cedematous. The right kidney was decapsulated *in situ* just as the left kidney had been, and multiple abscesses, some as large as cherries, were opened bluntly. Drainage with two sheets of rubber dam on either side of the kidney and tube between. Wound left open without any sutures. After this operation, the wounds on both sides being dressed and irrigated daily and rubber dam being withdrawn gradually; the patient's temperature became normal within two weeks. During this period several small areas in the right kidney were bluntly opened at dressings with palpating finger. From the right wound there was also moderate urinary leakage. Beginning the third week the patient had sufficiently recovered strength to be out of bed, and on June 22—about five weeks after his first kidney operation, he was discharged from the hospital.

In addition to the rapid recovery and the open method of treatment after decapsulation the most interesting features in this case are the apparently metastatic character of bilateral kidney abscesses; the absence of frank pus in the urine in some twenty-three examinations; and the remarkably firm union of both large lumbar wounds which had been left wide open without any sutures. Since the operation the patient has gained about forty pounds.

DR. CHARLES H. PECK said that although he had seen no case of bilateral multiple kidney abscesses, he had seen many cases of unilateral infection of the kidney. He considered that Doctor Beer's case emphasized one point and that was that these cases should be treated conservatively. In many of them the clinical symptoms will subside without operation. In another form abscess of the cortex will form without involving the pelvis or the urinary tract, and the urine remains free from pus. These can often be treated by local drainage without sacrificing the kidney. Only a small percentage go on to demand nephrectomy, even bearing in mind that the onset may be very sharp. With a little patience this violent initial stage will pass off and the patient recover.

DR. HOWARD LILIENTHAL referred to two cases he had had of bilateral multiple kidney abscesses which he treated the same as had Doctor Beer. The first was the result of a streptococcus infection of the face and the patient was in the hospital nine months. His second bilateral case was four years ago, a soldier in the American Army, who developed a phlegmon of the left arm and from that had lung abscesses and bilateral kidney abscesses. He was treated similarly to the first case and got well.

DOCTOR BEER believed that it is necessary to distinguish carefully between those cases with pyuria and colon infection and those cases without pyuria where the infection is probably due to coccic group of bacteria. In the latter, incision of the abscesses with decapsulation, at times resection of the infarcted area, and rarely nephrectomy seem indicated; whereas in the colon group nephrectomy, except in diabetics whose kidneys apparently are not able to take care of the multiple abscesses, is usually contra-indicated. If there is no obstruction to the outflow of urine, those cases usually take care of themselves, though some require decapsulation and, if stone is present in the ureter or pelvis, the removal of the stone may be necessary. The case that Doctor Lilienthal referred to, following erysipelas of the face, is a classic example of conservative treatment and has been quoted for years in literature. These cases of bilateral coccic infections of the kidney are very uncommon. He had seen only three similar cases and they were all treated as in the case presented with satisfactory end results.

#### SPLENECTOMY FOR HÆMOLYTIC JAUNDICE

DR. EDWIN BEER also presented a child, six years of age; admitted September 22, 1922. Present trouble began one week before admission with temperature and vomiting and progressive pallor. On admission, spleen five fingers below costal border. The liver was just palpable and there was a slight enlargement of the heart to the left, and a general adenopathy. Hæmoglobin, 43 per cent.; red blood cells, 2,000,000; white blood cells, 34,000; increased fragility of red blood cells; blood Wassermann negative; urine negative. While in the hospital on October 24, the patient developed some abdominal pain and icterus. On October 31 the temperature went up to 102, and icterus again became apparent. On December 12 the patient again had an attack of pain in the abdomen with tenderness and again became icteric. On December 13 the hæmoglobin had dropped to 32 per cent., and on December 17 there was again some icterus. The examination of the blood serum for bile showed a positive indirect VandenBergh, which, together with the increased fragility of red blood cells plus the enlarged spleen, made the diagnosis of hæmolytic jaundice. In the stools and urine there was an increase of urobilin. As the rest of the family showed no similar disturbance, this was apparently a case of acquired hæmolytic icterus in which there were icteric periods alternating with non-icteric periods.

Doctor Schwarz, on whose service the patient had been carefully studied, transferred the patient to the surgical service, where, on January 10, 1923, a splenectomy was done under gas-ether through a sub-costal incision. The spleen was found to be enlarged and was removed after ligation of the pedicle, abdominal wound being closed in layers without drainage. The pathological report from Dr. F. S. Mandlebaum is as follows: "The spleen removed from E. S. measures 11 x 8 x 4 cm. and weighs 225 gms. The surface is smooth and the vessels at the hilus are patent. The cut surface of the spleen is quite succulent and dark red in appearance with no visible evidence of fibrosis. The Malpighian

## CHRONIC BILIARY FISTULA

bodies appear numerous and considerably enlarged. Smears made from the fresh surface show a large number of red blood cells, the usual forms of white blood cells and a marked preponderance of lymphoid elements. Large numbers of agglutinated blood platelets are also present. Microscopic examination shows hypertrophy of the Malpighian bodies, marked congestion of the pulp, moderate phagocytosis, and the presence of iron pigment in the cells lining the sinuses."

The patient has made an uneventful recovery, two weeks having elapsed since the operation, and has had an absolutely afebrile course since the operation without any return of icterus. Five days after the operation, blood examination showed 80 per cent. hæmoglobin and 4,650,000 red blood cells.

DR. CHARLES H. PECK spoke of the satisfactory results from splenectomy in hæmolytic jaundice. He had operated on three cases in the past few years, one a boy of fourteen of the familial type; all have remained quite well. A fourth case, of the hereditary type, had cholecystectomy performed for gall-stones six years ago without splenectomy and had remained comparatively well without increase of symptoms, but the jaundice persists.

## CHRONIC BILIARY FISTULA

### IMPLANTATION OF SINUS INTO THE STOMACH

DR. HOWARD LILIENTHAL presented a woman, thirty-one years old, operated upon for cholecystitis with gall-stones in 1917, cholecystostomy and drainage having been performed. After two years of relief she began to have deep epigastric pain running to the back. She also had a gynecological trouble, for which she entered Mt. Sinai Hospital on September 20, 1921, where an amputation of the cervix for a non-malignant condition was done. It was intended to remove her gall-bladder when she should have recovered from the gynecological operation, but an acute suppurative cholecystitis came on two days afterward and necessitated a reopening of the gall-bladder without delay. This was done by Dr. Harold Neuhof, and by October 27 things had quieted down and she was ready for her radical operation. The external gall-bladder wound was still patent and discharging bile. The operation proved difficult, but was finally successfully performed, the common duct being incised and a number of stones milked out. The choledochotomy was a long one made in the direction of the duct, so that the great mass of calculous material and detritus could be expressed. Probing of the hepatic duct disclosed more stones which were removed as well as possible with the blunt curette. Probing into the duodenum was not entirely satisfactory, and, since the operation had lasted about an hour, and the patient was not in the best of condition, it was decided to terminate the procedure. A closely fitting rubber drainage tube was passed into the hepatic duct and held there by a single fine chromic catgut stitch. The stools of this patient had never been acholic, so it was hoped that when the hepatic tube would be removed the bile would again find its way out through the natural channels. This was not

the case, however, all the bile escaping at the wound even when the tube had been removed. About two months after the operation it did not look as if the bile would again find its way through the natural channels and it was decided to again operate to close the fistula, a formidable procedure in the presence of the mass of tough and extensive adhesions at the former operative field. On December 18, 1921, an incision was made transversely just above the old scar and continued upward in the median line for about three inches. The fistulous opening was circumcised, leaving a thin collar of skin and the sinus freed from its adhesions. When the stomach was reached the implantation of the sinus looked so feasible and tempting that it was decided to make the experiment. Accordingly a gastrotomy was performed about  $2\frac{1}{2}$  inches from the pylorus anteriorly and about one-third of the way from the lesser to the greater curvature. A straight needle was then plunged into the stomach through the greater curvature, carrying a piece of thick silk, and this, after traversing the interior of the stomach, was led out at the gastrotomy wound which had been made. The silk was fastened with a suture tied in a bow-knot to the tough structure of the fistulous tract near the skin. Traction upon the silk was made outside the puncture where it had entered the stomach. The fistula with sinus was drawn into that organ, where it was held by four or five chromicized catgut sutures passed through the outer coats of the stomach. Further inversion of the anastomosis was then made and maintained by suture. Before the last row of sutures was put in the end of the bow-knot which had been left outside was drawn upon, untying the knot so that the silk could be extracted through its place of entrance. To test the imperviousness of the suture line, a stomach tube was inserted through the oesophagus and the stomach filled with air, while water was dripped over the line of suture. No bubbles escaped. The wound was then closed in two layers with drainage by rubber dam. Three days later the patient stated that she occasionally brought up faintly bile-tinged mucus. A week after the operation, although there was no gastric leak, bile appeared for a time at the wound. This leak, however, was of short duration, and the wound then healed promptly. There was never a trace of icterus, the patient was greatly relieved, and she was discharged from the hospital apparently well about two months after the plastic operation.

DR. JOHN H. JOPSON said that a year ago he had presented a case operated on for biliary fistula in which he established an anastomosis between the first portion of the common duct and the stomach, that had remained in perfect health one and one-half years after the operation. Dr. Ellsworth Eliot, in 1917, read a paper on "Repair and Reconstruction of the Bile Ducts," collecting and analyzing all of the cases on record. Many methods were described by different operators in different series. He included at that time eight cases in which the hepatic or the common duct had been anastomosed with the stomach. A study of Eliot's paper makes one realize that there is a great deal to be desired in the end-results of many of these cases; attacks of pain and

jaundice are frequent in the post-operative histories. The chances of an ascending infection of the duct after operation probably increase as one goes down the bowel. The anastomosis can be made to the stomach with comparative ease, and there seems to be less chance of ascending infection than when the anastomosis is made into the duodenum or lower down in the intestine. The speaker had once completely divided the duct during an operation for cancer of the stomach, and performed immediate end-to-end suture with excellent result. The patient remained well after several years.

DR. FRANK H. LAHEY (by invitation) referred to two successful cases of transplantation of a common duct fistula into the duodenum. His own case was done on October 19, 1922, for a common duct fistula following operation for pancreatitis. The fistulous tract was coned out, care being taken to leave a thick wall about it to diminish the possibility of slough. This was transplanted into the duodenum, sewing a small No. 16 rubber catheter inside the fistula to maintain its patency during the healing. The abdominal wall was closed without drainage. The stools immediately became bile-colored and have remained so up to the present time. There has been no return of the fistula. This case was done without knowledge of a similar case done nine years ago by Dr. Hugh Williams at the Massachusetts General Hospital, who transplanted a common duct fistula into the duodenum and the patient, who has recently been seen by Doctor Williams, has remained entirely well with bile-colored stools and no return of the fistula up to the present time.

DR. JOHN GIBBON brought up the question whether so many persistent common duct fistulæ would occur if one did not remove the gall-bladder in the presence of stone, sand or mud in the common duct. He was convinced that it is a mistake to take the gall-bladder out when there is cholangitis. If the gall-bladder is left, the common duct can be drained and no fistula will follow. The common duct, if drained in the absence of the gall-bladder, remains open much longer than when the gall-bladder is present. If the gall-bladder is left in the above conditions these persistent fistulæ will not occur.

DR. WILLIAM A. DOWNES wished to know the experience of the members with reference to the permanency of a cure in operations for injury to the common duct. Six years ago in operating for gall-stones, he accidentally removed about one inch of the common duct and an end-to-end suture was done, which seemed to be very satisfactory. The patient was lost sight of, but a few days ago he turned up in the hospital intensely jaundiced. He was operated upon, and after freeing the duodenum, which was found adherent to the under surface of the liver, a half inch of dense cicatricial tissue was found at the site of the injury in the common duct. The cicatricial material was excised and a T tube inserted. He is convinced that these cases of injury to the duct, no matter how satisfactorily repaired, contract, and that this is the usual result. If the duct is injured, he wondered if it would not be wise to immediately anastomose the duct to the stomach or duodenum. The above case is the only one of injury to the common duct in his own hands,

but he had operated upon four other cases in which the duct had been injured and the late results have been satisfactory in only one case.

DR. JOHN DOUGLAS answered Doctor Downes' question to a certain extent. About one year ago he showed a patient who had destruction with separation of about 1 cm. of the common duct due to a bad sloughing and infection following cholecystectomy for a gangrenous gall-bladder. Three months before showing her, he had operated for the repair of the duct. He dissected the duct, sutured it together end-to-end and put in a T tube. The patient accidentally pulled out the tube within two weeks, but went out of the hospital apparently cured. She had remained well up to the time of showing her before the society three months later. About two months later she became jaundiced and had marked itching of the skin and clay-colored stools. She was given medicine to increase the flow of bile and finally the jaundice cleared up. That has happened to her three or four times in the past year. After acute attacks of pain her symptoms of biliary obstruction disappeared, probably due to pressure dilating again the stricture in the common duct, which has too small an amount of epithelial tissue lining the point of repair not to contract down.

DR. ALEXIS V. MOSCHCOWITZ said that he had a very peculiar experience within the past two years in connection with biliary fistula which he would like to place on record. About two and one-half years ago, he had occasion to do a simple cholecystectomy for cholelithiasis. The operation was exceedingly simple and easy; in fact, the entire operation did not last half an hour. The specimen removed was the gall-bladder filled with calculi and a short stump of the cystic duct. The patient did well for three or four days, then suddenly jaundice developed which persisted for about one week and ceased only after the discharge of a slough from the depth of the wound, whereupon a biliary fistula formed. This biliary fistula remained permanent. He reoperated and found an opening on the under surface of the liver which was apparently the hepatic duct. No trace of the common duct was found after a two-hour search. He introduced a tube into the opening into the liver (hepatic duct), made an opening into the duodenum through which the hepatic tube was introduced, and sutured it into place. Again a biliary fistula formed which has remained open to date. All the bile is discharged externally, but in spite of this she has remained in perfect health and for the present does not wish any further operation. In view of the simplicity of the first operation, Doctor Moschcowitz is inclined to believe that there was some unrecognized abnormality in the blood supply to the common duct. It was this which caused the sloughing of the duct and the formation of the biliary fistula.

DR. GEORGE P. MULLER three months ago operated on a patient for stricture of the common duct. The patient had been suffering from jaundice and loss of weight, following a previous cholecystectomy. At operation when the stricture was dissected out, the stump of the common duct was found to be within one-eighth inch of the junction of the right and left hepatic ducts.



## OPERATIVE REMOVAL OF BRAIN TUMORS

A T tube was introduced, one end into the common duct and the other end split, one-half being placed in the right hepatic duct and the other in the left. The ends of the duct were partly sutured and omentum wrapped around the joint. The jaundice cleared up and the patient is now in perfect health. About four ounces of bile is discharging daily through the tube. The speaker said he is afraid to take out the tube. It has been in place three months, and sooner or later must come out, but he is fearful of recurrence of the stricture.

DOCTOR LILIENTHAL, in closing, expressed his belief that tubes in the common duct are apt to cause necrosis and consequent scarring which results in the persistent fistula. It seemed to him that these fistulae are much more rare now than they used to be when the gall-bladder was left in. With the removal of the gall-bladder the common duct is more carefully explored and all stones removed. If the gall-bladder is left in there seems to be a more persistent fistula than if it is removed. In his case, the fistula transplanted into the stomach is a safety valve. If the epithelium should reestablish itself in the common duct the bile may run through the natural passage. The operation is easy, and in suitable cases it may be well worth trying rather than to make a difficult and dangerous dissection. It does not prevent one from operating again if it should be thought best to make another attempt to reestablish the choledochus.

## OPERATIVE REMOVAL OF BRAIN TUMORS

DR. CHARLES A. ELSBERG presented a patient from whom he had removed a large endothelioma from the right parieto-frontal region, in June, 1922. The patient had suffered from severe headaches and failing vision. He recovered completely from the operation and was presented perfectly well.

A second patient from whom he had removed a large endothelioma from the anterior part of the left temporal lobe in August, 1922, was also presented. The tumor had given her mainly mental disturbances and subjective sensations of numbness in the left hand. At the operation a large endothelioma was removed from the fronto-parietal region. The patient recovered completely and was presented perfectly well.

DOCTOR ELSBERG also presented a third patient who was seen in status epilepticus, and from whom he removed a large endothelioma ten days before. Excepting for slight weakness in the right hand, the patient had recovered entirely.

In connection with these cases, all of whom were operated upon under local anæsthesia, Doctor Elsberg spoke of its advantages in many operations for brain tumor. He also spoke of the difficulties in characterizing the histological structure of these tumors which were derived from the membranes and were usually adherent to the dura. They had been called by different names; most often they have been called endothelioma, and on account of the diversity of opinion, Doctor Cushing has recently taken a backward step in a forward direction by calling them meningioma. The tumors can clinically be divided into two

## NEW YORK SURGICAL SOCIETY

groups, those that have a well-marked capsule which is often vascular, and those that have a thin or ill-defined capsule.

DR. J. S. RODMAN stated that endothelioma was the best type of tumor of the brain in which to obtain favorable results. One of the difficulties in operating for brain tumor is the matter of increased intracranial tension, and the speaker asked Doctor Elsberg how he managed cases of hypertension and what he thought of intravenous injections of hypertonic salt solution. The idea of this is, of course, to decrease brain bulk and Doctor Rodman said he had used it in a few traumatic cases, where he believed it to be of value. He also asked Doctor Elsberg what he thought of radium and X-ray treatment in inoperable tumor of the brain.

## PROLAPSE OF THE RECTUM

DR. A. V. MOSCHCOWITZ presented the history of a patient with prolapse of the rectum whom he operated upon three or four months ago. The patient had been suffering from symptoms of this prolapse for about a year. The case was one, however, of much gravity. She was practically bedridden, as only in the recumbent position did the prolapsed rectum return to its normal position. The sphincters were so stretched and atonic, that they did not give any support whatsoever to the rectum. The operation was the one done as a routine measure by Doctor Moschcowitz. The patient made an absolutely uncomplicated recovery and was discharged from the hospital three weeks after operation.

DR. GEORGE P. MULLER had done this operation five times, the first two in 1914 and the third in 1915. The others had been done more recently. As far as he knew no patient has had a recurrence, and the condition of the earlier ones is known. The only objection to Doctor Moschcowitz's operation is that it is very hard to perform; it is difficult, especially in the male subject, to keep the intestines sufficiently out of the way to place the first purse-string suture.

DR. WILLIAM JOHN RYAN said that the first case he operated on was five years ago and he saw the patient three years afterward, and there had been no recurrence. In two other cases operated on two years ago, there was no recurrence one and one-half years later. A technical difficulty mentioned by Doctor Muller can be overcome by anæsthetizing the patient in the Trendelenburg position. When the abdomen is opened it will then be found that the intestines have gravitated upward and can easily be packed out of way.

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY

*Stated Meeting Held February 14, 1923*

DR. WILLIAM A. DOWNES in the Chair

## INTRAUTERINE PERIOSTEAL SARCOMA OF THE HUMERUS

DR. WALTER A. SHERWOOD presented a female child, born in May, 1920. Forceps delivery. At birth it was noticed that the left arm was swollen considerably beyond the normal contour. The physician, assuming that the arm had been broken, had an immediate X-ray made. It was reported that there was a fracture in the mid-portion of the shaft of the humerus and that a large callus formation was present; the condition was therefore interpreted as an intra-uterine fracture.

The swelling, however, steadily progressed, and so rapidly that the mother stated that she could notice a daily increase in size. There were no other symptoms or abnormalities. The child was admitted to the Brooklyn Hospital when three weeks old. Except for the local tumefaction, the infant was in good physical condition; the movements of the arm were not restricted. There was no elevation of temperature or pulse-rate and no evidence of inflammatory reaction. Over the left arm was a large, firm, fusiform swelling extending from the elbow almost to the shoulder and having a maximum diameter of about three and one-half inches. (Fig. 1.) The overlying skin was bluish in color, tense, and at its most prominent part the tumor seemed to be semi-fluctuant. An X-ray made at the time of admission showed the fracture before mentioned, together with the shadow of a tumor and considerable callus at the site of fracture. An exploratory incision was considered advisable for diagnostic purposes; this revealed friable tissue which bled so profusely that it was necessary to tampon the wound. A section of tissue removed was reported as sarcoma, the exact histological nature of which could not be determined. The character and rapidity of the growth were such that amputation seemed imperative, and three days later a disarticulation at the shoulder joint was done. Wound healing was prompt and post-operative convalescence was rapid and satisfactory.

It is now two years and seven months since the child left the hospital and during this period the patient has been carefully followed and examined at regular intervals. The growth and development of the child have been normal and at no time has there been any evidence of local recurrence or remote metastases.

The interesting features of this case are: First.—The apparent intra-uterine origin of the growth. Second.—The question of the pathology.

Any case reported as living for more than a year without recurrence or metastases following operation for periosteal sarcoma of long bones immediately casts suspicion on the accuracy of the pathological studies and reports. The gross specimen and numerous sections were carefully studied by our own staff and particularly Doctor Denton and sections and photographs were also submitted to Doctors Ewing and Bloodgood. Herewith is appended the opinion of Doctor Bloodgood, dated February 5, 1922:

"X-ray.—Shows a tumor shadow surrounding the lower two-thirds of the shaft of the humerus, extending over the elbow and upper third of radius and ulna. We can see new periosteal bone along the lower half of the shaft of humerus, extending into the tumor, and lighter shadow of the marrow suggests tumor infiltration. The photograph of the specimen (longitudinal section) shows a huge periosteal mass, with cystic areas, discolored by blood. The tumor is opaque white. (Fig. 2.)

"In the section sent me I can see tumor tissue invading fat, and separated from the epidermis by derma and fat. The tumor is somewhat circumscribed by dense fibrous tissue stroma, apparently fascia. Islands of fat are seen throughout the tumor. Also cavity formation, lined by tumor cells, containing desquamating tumor cells. The tumor is pretty homogeneous, cells larger than lymphoid cells, roundish, of different shapes, the so-called oat-cell predominating.

"Stroma.—Even in the densely cellular areas, the cells are embedded in a stroma which stains lightly with eosin. In other areas the cells are more separated by this stroma, giving it a myxomatous appearance, but no typical myxoma. There are numerous blood-vessels throughout the tumor, with thin walls, and some with thick, fibrous walls. I see no giant cells, no cartilage or cartilage cells; no bone. I do not know whether we could call this a primary osteogenetic tumor. It could easily be a primary tumor of the soft parts invading bone. For practical purposes it is to be classed with periosteal sarcoma.

"Doctor Denton's report on the gross appearance of the arm is that it presents a large globular swelling in the bicipital region, which extends on to the upper forearm. The swelling measures 7.5 cm. in the antero-posterior diameter and 5.5 cm. in the lateral. On the anterior surface there is a recent incision through the skin, 4 cm. long, opening directly into a cavity, 3.5 cm. deep. This cavity contains old blood clot mixed with disorganized tissue. The surrounding skin is purplish in color. Cross section of arm reveals a large tumor mass anterior to humerus. The outer surface has a grayish-yellow hue and shows a mottling of many large and small hemorrhagic areas, some of which are semi-cystic. The growth is attached to the periosteum around the middle third of the humerus, where there has been a fracture, now united, and presenting well-marked callus formation. It would seem that the tumor had originated about the site of fracture. The remainder of the humerus appears normal. The forearm is flexed to a right angle. The ulna is slightly bowed.

"Microscopic Examination.—Sections show the tumor to be composed of closely packed, short, fibroblastic cells with relatively little inter-



FIG. 1.—External appearance of tumor of arm.



FIG. 2.—Gross appearance of longitudinal section of specimen after removal of extremity.



## RESECTION OF STOMACH FOR ULCER

vening collagen. Hyperchromatic nuclei and mitotic figures are fairly numerous. No giant cells observed. The neoplastic tissue infiltrates muscle, nerves and fat. Portions of the growth in proximity to the large cavity noted in gross show extensive necrosis and leucocytic infiltration. In this vicinity and elsewhere large areas of hemorrhage are present. The tumor is probably derived from the periosteum."

This case may be classed as a true periosteal sarcoma of intra-uterine origin and is presented as such. It has been reported to the Codman Sarcoma Registry (number 68) by Dr. J. H. Long, who with the reporter has been jointly interested in the surgical care, pathological study and post-operative observation of the patient.

## RESECTION OF STOMACH FOR ULCER IMMEDIATE FEEDING WITH DUODENAL TUBE

DR. HERMANN FISCHER presented Mrs. M. M., age forty-nine years, admitted to the Lenox Hill Hospital, December 27, 1922. Chief complaint, pain in abdomen and loss of weight for last two months. At that time patient began to have sharp pain in the upper part of the abdomen and on the left side. Frequently this pain would come on shortly after eating. Nauseated but seldom actually vomited. These symptoms have become increasingly severe. She derived some benefit, but had lost 20 pounds. Physical examination showed tenderness in the epigastrium, but no palpable masses. No other abnormalities. Fluoroscopic, combined with röntgenological examination, reveals a distinct hour-glass stomach due to ulceration on the lesser curvature.

Operation, December 30, 1922.—Median incision from ensiform to umbilicus. On opening the abdomen very extensive and broad adhesions were found, running from the free border of the liver to the stomach and from there on to the anterior abdominal wall. The adhesions were so dense and extensive that the whole anterior surface of the stomach, including the gall-bladder, were concealed by them. After freeing the organs from these adhesions it was found that we had to deal with a large hour-glass stomach, caused by a penetrating ulcer, situated halfway between the pylorus and the cardia. Remembering that in hour-glass stomach multiple ulcers in the pyloric region of the stomach often occur, he decided to resect the entire pyloric portion. A resection after Billroth was done.

In his gastro-intestinal work, he was always very much impressed by the difficulty of feeding these patients after the operation. Although he had never hesitated to administer small quantities per mouth as early as four hours after the operation, their suffering from thirst was not materially relieved, as the quantities one dared to give were of necessity small. In a good many cases nausea and vomiting also interfered. hypodermoclysis and Murphy drip do not alleviate the thirst of the patient, who is always more or less dehydrated and emaciated. These methods of artificial feeding often add considerably to the discomfort of the patient, whose nervous system and whose whole constitutional resistance has been severely tried by an operation of such magnitude. He therefore decided to feed these patients immediately, by the introduc-

tion of an Einhorn duodenal tube into the jejunum. This was done in the following manner: After the posterior walls of the stomach and the duodenum were sutured together and before the anterior sutures were introduced, an assistant introduced a stomach tube through the mouth. After the stomach had been emptied of some fluid which had accumulated during the operation, the clamps were removed from the stomach. The tip of the stomach tube was now caught by a pair of forceps and drawn through the wound. An Einhorn tube was now inserted into the eye of the stomach tube and fastened there by a silk suture and both tubes were withdrawn through the mouth. The end of the Einhorn tube was secured to the cheek of the patient and its tip which projected through the stomach wound was guided into the duodenum and pushed down into the jejunum for about two feet.

The anastomosis was now completed and the patient was given immediately one ounce of whiskey and three ounces of water at blood temperature. Four hours after the operation regular two-hourly Einhorn feedings were given with enough water in between the feedings to allay thirst. The tube was withdrawn on the eighth day and a semi-soft diet allowed per mouth. During the whole time the patient felt very well, had no thirst, no vomiting, no nausea, in fact, suffered no inconvenience at all after the operation. The usefulness and simplicity of this method of immediate feeding is quite obvious. The first report of the use of this method is by Anderson (*ANNALS OF SURGERY*, May, 1918).

DR. RICHARD LEWISOHN said that in penetrating ulcers of the lesser curvature direct anastomosis (Billroth I) is not difficult if the stomach is freed extensively. It is remarkable to what extent both the stomach and duodenum can be mobilized after careful ligation of the vessels. Haberer has performed Billroth I in cases where more than two-thirds of the stomach was removed; yet it was possible to bring the two ends together without tension. Haberer has performed a few hundred Billroth I for gastric and duodenal ulcers with a remarkably low mortality (4 to 5 per cent.).

DR. DEWITT STETTEN spoke of a tendency in Europe to return to the Billroth I type of operation. In addition to Haberer, Schoemaker of the Hague is doing this operation, for which he has devised a special clamp for the resection and reconstruction of the lesser curvature. During the past summer, Doctor Stetten had the opportunity of seeing Schoemaker, with whom he discussed the question and whose statistics he had the opportunity of inspecting. Schoemaker's mortality was about two per cent. It is generally conceded that the functional results after the Billroth II operation have not been entirely satisfactory. Hence the tendency has developed to attempt to reconstruct, as far as possible, the normal anatomical relationship between the stomach and duodenum after resection. Doctor Stetten has been waiting for a case in which to apply the Schoemaker clamp, but has as yet not succeeded in finding one in which he could sufficiently mobilize the stomach for its application. He believes, however, that in suitable cases the Billroth I opera-



## PRIMARY ULCER OF THE JEJUNUM

tion should in some way or another be attempted and that the results ought to be more satisfactory in the end than the usual posterior gastro-enterostomy.

DOCTOR FISCHER, in closing the discussion, said that he showed this case as a successful example of post-operative feeding with the Einhorn duodenal tube, and was sorry that this phase had not brought out some discussion. He has done the Billroth I several times with good results. In this case he had no difficulty at all. It was not necessary to mobilize the duodenum as the parts came together rather easily. There is no doubt that in all those cases where one can establish the outlet of the stomach at the proper physiological point, this method is best.

## PRIMARY ULCER OF THE JEJUNUM

DR. HERMANN FISCHER also presented the case of a female, age forty-two, who entered the Lenox Hill Hospital on May 23, 1922, for the relief of (1) intermittent epigastric pain, (2) dyspnoea, (3) profuse night sweats, and (4) slight hoarseness. Present Illness.—For the past year, over long and irregular periods, the patient has had attacks of tight constricting epigastric pain, originating in the pit of the stomach and radiating along both sides to the back. The attacks of pain last from two hours to five days. No definite relation to meals can be found. No vomiting. During the past two years there has been vertigo, palpitation and chills at irregular times. Her preceding history is quite irrelevant.

Her physical examination was conducted with the utmost care and thoroughness. The only positive findings were occasional extra systoles and a faint systolic murmur at the apex of the heart not transmitted. Red blood-cells, 2,770,000; hæmoglobin, 55 per cent.; white blood-cells, 5000; polymorphonuclears, 76 per cent.; lymphocytes, 24 per cent., no atypical cells; blood-pressure, 110/50; blood, Wassermann, negative to both antigens; blood group, No. 1 (for transfusion); stools, no parasites (guaiac test not done); urine normal. Fluoroscopic, combined with röntgenographic examination, revealed no defects in the outline of the stomach or first portion of the duodenum that would indicate ulceration or malignancy; gall-bladder negative. She remained in the hospital until June 6, about two weeks. She was on soft diet, was kept out of doors in the sunshine as much as possible, and received Bland's pills 2 t.i.d., and Fowler's sol. m.v. t.i.d. a.c. She left feeling improved. A repeated blood count showed practically the hæmoglobin percentage and red blood-cells, and was discharged with the diagnosis of a secondary anæmia of unknown origin.

On August 25, about two months later, she returned complaining of gradually increasing weakness with dizziness, palpitation, dyspnoea, cyanosis and also paleness after exertion. Also had a "light feeling" in head after exertion. Her pain now was in the right loin. This pain was a new development. It originated in the right loin, radiated to the right scapular region and was worse at night. Physical examination as before was almost entirely negative. Three X-ray examinations were made. The first suggested gastropexia, and a questionable diverticulum

of the sigmoid. The second with a barium clysma raised suspicions of malignancy of the cæcum and the ascending colon by a break in the barium shadow in the ascending colon. The third did not reveal the same deformity, and that diagnosis was recalled. Stools.—Daily examination revealed blood to be present, no parasites. Red blood-cells, 1,600,000; hæmoglobin, 25 per cent. Blood transfusion was done August 27. On discharge the red blood-cells, 2,800,000; hæmoglobin, 34 per cent. Discharged on September 23, improved, with diagnosis unchanged.

During the following month her stools still showed blood, she lost four pounds in weight, had no appetite, no pain, and her anæmia increased. She was advised to return, and on October 4 was admitted to the surgical ward on Doctor Fischer's service. On October 8 she was transfused with 550 c.c. of blood. The next day an exploratory laparotomy was done by Doctor Fischer.

*Operative Procedure.*—A long median incision from ensiform almost to pubes was made. The exploration of the large gut, stomach, gall-bladder and other organs revealed no macroscopic pathology. At the duodeno-jejunal junction an induration of the wall of the jejunum was found, about the size of a quarter. The wall of the gut was irregular, very much thickened and oedematous. The serosa of the intestine was scarlet red and covered with a few flakes of fibrin. This oedema and inflammatory thickening was also noted in the root of the mesentery and above the intestine in the mesocolon. The retroperitoneal portion of the duodenum was also implicated in the process. The diagnosis of a primary ulcer of the jejunum was made and it was decided to do a retrocolic duodeno-jejunostomy. The descending portion of the duodenum was mobilized after Kocher, pulled through a hole in the mesocolon and anastomosed with the jejunum about 25 cm. below the seat of the ulcer. During the first forty-eight hours there was considerable vomiting which was finally relieved by gastric lavage, thereafter a smooth convalescence. She still has blood in her stools. Blood examination showed the following: Red blood-cells, 2,560,000; hæmoglobin, 35 per cent.; at her reëxamination on February 11, 1923, but all her pain and discomfort and the anorexia from which she suffered have disappeared. She has gained about ten pounds.

DR. WILLIAM A. DOWNES said he would be interested in the future of this case. In doing an exploratory operation recently he had the misfortune to overlook an early carcinoma of the jejunum. The growth was about three inches beyond the duodeno-jejunal angle. The patient later returned and died in the hospital. This growth was found at autopsy. Symptoms were those of hemorrhage. When indicated duodeno-jejunostomy is an operation of great value.

DR. DEWITT STETTEN had seen an autopsy in a case similar to the one mentioned by Doctor Downes. The patient had been slightly jaundiced and had been turned over to him for operation, with the diagnosis of either duodenal ulcer or cholelithiasis. The night before the patient was to be

## PULMONARY LIP FISTULA

operated on, he had a very severe gastric and intestinal hemorrhage. The operation was postponed. Unfortunately, this was before the days when transfusion was commonly practiced. The patient, on the following day, had another very severe hemorrhage and died before anything could be done. Autopsy showed an extensive carcinoma of the transverse portion of the duodenum extending up to the duodeno-jejunal junction. Doctor Stetten feels that possibly Doctor Fischer's patient may be suffering from a similar condition in spite of the temporary improvement after the duodeno-jejunostomy.

DOCTOR FISCHER, in closing, said that he did not consider this patient cured. She still has small amounts of blood. But her hæmoglobin is 35 per cent. and she has gained ten pounds in weight, so she is improved. He was not sure of the non-malignancy of the condition in this case, although its appearance was that of a simple ulcer.

## PULMONARY LIP FISTULA

DR. WILLY MEYER showed a man who had been well until twenty-four years of age when, without any apparent reason, without having passed through a nasopharyngeal operation, pneumonia or influenza, he developed a lung suppuration of intense character with extremely foul and massive sputum, and was declared to be tubercular. He went to the mountains for a long time. There he developed an external abscess which was opened. Conditions did not improve. He came under the reporter's care in the fall of 1916, much run down and daily expectorating large amounts of foul sputum. Under local anæsthesia a piece of rib was resected, establishing better drainage. The exploring finger entered a large and deep cavity within the lung. Having seen lasting benefit result from prolonged drainage and thorough ventilation, the skin was stitched to the borders of the opened lung in order to produce a lung lip (pulmonary lip) fistula. The patient continued to expectorate large amounts of sputum for a little while. He was given oxygen inhalation through the wound and made to breathe through it. About two weeks after the operation, the odor had completely disappeared. The left arm, that had become tied down to the chest by the inflammation of the pectoral muscles in consequence of the extra-pleural suppuration, had been freed by dividing the muscles at right angles to their fibres during the operation. Now he has what one might well call "a burned-out crater" in the lung; the probe goes down for three inches into a large irregular cavity, wide open in all directions. He has no more expectoration and is well and happy, holds an important position, rides the bicycle and plays tennis. I advised him to be careful not to take a full bath; but recently he forgot this and while in the bathtub leaned back and the cavity filled with water. He leaned sideways quickly and the water ran out.

The case represents a principle. It proves that in these extremely run-down patients who cannot stand lobectomy one can still help by

making a thorough incision and unobstructed drainage with ventilation of the lung to the surface, not allowing the wound to heal by letting scar form around the opening (lip fistula). This patient is entirely well six and a half years after the operation and has full use of his arm. Lately he developed a slight hemorrhage through the wound subsequent to mental excitement. Direct inspection with the thoracoscope (pulmonoscope) shows below a projecting portion of the irregular crater a whitish crust, evidently adherent to an ulcerated surface, the other parts of the cavity being healthy, moist and glistening.

#### SARCOMA OF THE CLAVICLE

DR. JOHN F. ERDMANN reported a case of sarcoma of the clavicle, a male, sixty years of age, who was struck on the left clavicle by a flying piece of machinery about the latter part of September, 1922. The patient was observed for a period of thirteen to fourteen weeks. When he came to Doctor Erdmann's service at the Post-Graduate Hospital, he presented a tumor about the size of a small peach in the mid-portion of the clavicle, extending downwards and upwards each way about two to three fingers' breadth. The doctor who was in attendance aspirated the tumor, thinking that it was a hæmatoma. Nothing but blood was found. Close examination presented no cells of a malignant nature. Observation was made for another week, during which time the growth increased in size. An X-ray showed a multi-fracture with a question of osteosarcoma. The second, much clearer X-ray within a week, presented all of the evidences of osteosarcoma. A complete enucleation of the clavicle was done January 13. At the present time, February 14, the wound is thoroughly healed and the patient has practically complete function. Pathological report is that of cystoblastic sarcoma. Doctor Erdmann states that this is the second sarcoma of the clavicle which he has removed in a period of five years. The first was a patient twenty-one years of age.

DR. FRANK S. MATHEWS said he had recently removed a clavicle for a solid central tumor of its outer end, which had not broken through its bony capsule. The pathological report was myeloma; there was no evidence at the time, however, of its being the well-known generalized myeloma. Six months after the operation the patient developed multiple tumors in the skull, the opposite clavicle and humerus, and died. The case was unlike ordinary bone sarcoma in that the recurrence selected bone rather than lung.

DOCTOR ERDMANN, in closing, said that he expected to use radium and X-ray in this case but did not know what good would be obtained from it. He feared there was something more than adhesive or cohesive there. No consideration had been given to the use of Coley's serum on account of the findings.

## ISCHÆMIC FAT NECROSIS

## ISCHÆMIC FAT NECROSIS

DR. CHARLES E. FARR read a paper with the above title, for which see page 513, *ANNALS OF SURGERY*, vol. lxxvii.

DR. BURTON J. LEE said that there had been five cases of traumatic fat necrosis of the breast in five years at the Memorial Hospital. The first had a complete amputation for supposed carcinoma, but no carcinoma was present in the pathological specimen. There are always giant cells and large syncytial cells lining the large spaces containing confluent fat. Having encountered this first case, Doctor Adair and he were on the lookout for others, and during the last four years had encountered four other examples of this condition. In all there was a definite history of trauma. Three had had a hypodermoclysis beneath the breast and the tumor was located at this site. More recently a few surgeons had sent the speaker reports of other cases. Doctor Bloodgood had a case in which amputation had been done for carcinoma, which showed the typical picture of traumatic fat necrosis. Up to the present time there are eight cases which are definitely proven to be traumatic fat necrosis. In the Breast Clinic at Memorial Hospital the percentage of traumatic fat necrosis to primary carcinoma of the breast is four per cent. Doctor Lee believes that a more thorough pathological search will not infrequently show a small proportion of presumable carcinomata of the breast to be really cases of traumatic fat necrosis.

DR. DEWITT STETTEN said that the matter of fat necrosis was first called to his attention shortly after the appearance of Doctor Lee's paper by a woman who had a typical breast tumor with puckering and adherence of the skin. There was an indefinite history of trauma. The skin was slightly reddened and had an infiltrated appearance, which, however, is not infrequently seen in carcinoma. With Doctor Lee's paper fresh in his mind, he excised this tumor for examination, and it was found to be a mass of infiltrated fat having the appearance of having been hardened in formalin. The microscopical examination showed it to be a traumatic fat necrosis. Shortly after this experience he saw another case of a tumor in the femoral region which was variously diagnosed as neoplasm, femoral lymphadenitis or saphenous thrombosis. There was no history of antecedent trauma or infection. The mass was excised and found to be a fat necrosis with typical inflammatory reaction, showing numerous foreign-body giant cells. The interesting feature in this case was that after the wound had healed, an indurated reddened area developed at the inner side of the scar. This area eventually opened, exposing a fat slough down to the fascia, in appearance very much like that of the necrosis which has been noted after the subcutaneous injection of salvarsan. Although there was no luetic history and previous Wassermanns had been negative, a later Wassermann was 4 plus and the patient was put on rigid antiluetic treatment, under which the wound finally healed after some eight weeks.

## NEW YORK SURGICAL SOCIETY

DR. ALEXIS V. MOSHCOWITZ said that he liked the word ischæmic in contradistinction to traumatic fat necrosis. He had seen a few cases, which were due to the too energetic application of ice bags to the abdomen. On operating on them a definite necrosis of fat was found.

DOCTOR FARR, in closing, said that there have been a number of cases of fat necrosis following operation and he has seen cases where the skin and aponeurosis healed, but there was degeneration of the fat, and this is presumably fat necrosis. In preparing this paper the speaker looked up several hundred references and found four or five cases of undoubted traumatic fat necrosis, and found that one man had succeeded in reproducing the condition in a cat.

## CORRESPONDENCE

### TREATMENT OF TRAUMATIC SYNOVITIS

EDITOR ANNALS OF SURGERY:

Sir:

I was greatly interested in Dr. Clarence A. McWilliams' paper in the ANNALS OF SURGERY, vol. lxxvi, No. 6, p. 677, and would like to offer an improvement in the treatment he there advocates which has been found of advantage in a very considerable number of cases by me. I quite agree with him that immobilization, plaster-of-Paris, splints, and even elastic knee-caps, are all an abomination, and relatively noxious in the order named. The point in which I would join issue with him, however, is the question of aspiration. In many cases of hæmarthrosis, I believe aspiration is uncalled for, as long as immobilization is avoided.

I believe two main causes exist for the prolonged convalescence or incapacity, formerly so common in these cases. First, the extreme atrophy of the extensor muscles of the thigh, and secondly, the custom of putting these patients to walk as a first exercise of convalescence. The first of these is efficiently prevented by allowing the patient to make as much active movement as he can without pain. In a word, active mobilization of the joint in bed. The second is avoided by giving the patient a series of exercises of gradually increasing strain, so that he is led by easy stages to indulge in walking and all the other functions of the joint.

The following is a brief outline of the treatment. The patient is put to bed without any confining apparatus, no icebags or local applications of any kind are applied. He is told to extend and flex the knee as much as he can without pain, and as often as he can. The effusion disappears much more rapidly than when confining apparatus or splints are used, and atrophy of the muscles does not appear. Aspiration is only done when, obviously due to rupture of a large vessel, the tension becomes extreme, and if aspiration be done, not immediately, but two or three days after the occurrence of the traumatism, the hemorrhagic effusion does not recur. Pure synovial tension never exceeds the limits of safety, and quickly disappears.

When the fluid has disappeared, generally in the course of a week or so, the patient is directed to sit on the edge of his bed, or on a table, in such a way that his legs dangle, and he is instructed to make flexion and extension movements as often as he can, the latter as forcibly as he can. In a day or two he can do these thousands of times, resting when either tiredness of the muscles (extensors) or the appearance of pain indicates to him to desist. As his power increases, weights of from one to two kilos are attached to his foot to increase the effort, and in about a week more he may be allowed to

## CORRESPONDENCE

put his foot to the ground. Walking at first is done tentatively, and increased as he regains his power, and generally at the end of twenty days from the date of injury he will be up and about all day.

ROBERT E. HALLAHAN, M.D.,  
*Buenos Aires, Argentina.*

## GONOCOCCUS MYOSITIS

EDITOR ANNALS OF SURGERY:

Sir:

In the ANNALS OF SURGERY of December, 1922, there appeared a communication of Wm. J. Fulton, of Baltimore, under the caption "Gonococcus in Arm Abscess." I quote therefrom: "The following case is reported because the appearance of the gonococcus in the ordinary abscess or sinus has been rarely if ever recorded in literature."

I beg leave to submit that I have reported an abscess of the muscle of the arm under the caption "Gonorrhœal Myositis" in The American Journal of the Medical Sciences, July, 1901, citing four other instances of the finding of the gonococcus in the soft parts. Furthermore, in the 6th Ed. Finger (1905), Die Blenorrhœa der Sexual Organe, a description of blennorrhagic myositis is offered with additional cases and commented to be "not altogether a rare complication," in support of which I refer to additional instances of Becker, Decousse and Harris and Haskel, all reported in Jahresb. d. Urogenital Apparat., 1905.

In my own cases as well as the others the gonococcus could not be recovered from the pus upon culture, though in other respects it behaved tintorially Gram-negative and appeared morphologically as does the gonococcus. Doctor Fulton reports like experience.

The foregoing are instances of metastatic infection of the gonococcus. Against these the correspondent's case merits signal consideration as instancing a cellular abscess "*in loco*" by direct inoculation of the gonococcus.

MARTIN W. WARE, M.D.,  
*New York City.*

## PREVENTION OF FAT NECROSIS IN INCISIONS

EDITOR ANNALS OF SURGERY:

Sir:

In wounds that do not heal by first intention fat necrosis is, in many instances the first phenomenon observed. It is felt that this is the direct cause of failure to obtain primary union, in many cases.

How does fat necrosis occur and what are its consequences? The following statements are evident: (a) fat is seriously traumatized very easily and is inevitably traumatized in all surgical operations; (b) it is the least resistant tissue to infection; (c) has very little power of absorption; (d) hæmatomata are best prevented by close approximation of living tissues; (e) exces-



sive use of ligatures is harmful; (f) healing is retarded by the presence of foreign bodies.

When an incision is made the fat is severed; large blood-vessels are clamped and tied, smaller vessels are controlled by sponge pressure, application of hot wet towels or sponges; retractors, towels or sponges are applied against the layer of fat. When one realizes that fat is constituted of a network of connective tissue holding cells of fat, which are very friable and easily dissolved, it is not difficult to appreciate that a portion of the cut edges of the layer of fat will be dissolved, the amount corresponding to the amount of trauma to which it has been subjected. It is also easily appreciated that oozing of dissolved fat in the wound will continue after the wound is closed, because hæmostasis and trauma have deprived the superficial fat of its vitality. This favors: (a) hemorrhage by greasing the cut ends of the capillaries and smaller blood-vessels; (b) prevents the immediate early healing of the approximated tissues; (c) and causes accumulation of fluid fat and blood at the bottom of the wound. Thus, owing to the low resistance of fat to infection, its poor power of absorption, presence of catgut, moisture and heat, we have an excellent medium for the growth of microorganisms.

In practically all clean cases and in many infected ones fat necrosis can be prevented by the following simple procedure: after muscles and fascias are sutured, the cut edges of the fat from the skin to the fascia are cut with the sharpest knife obtainable, so that a strip of fat of the thickness of about three to five millimetres is cut away as cleanly and rapidly as possible and the wound is immediately closed. In this manner we have shaven off the layer of fat which has been traumatized and infected and we have removed the portion which would have dissolved most easily. In infected cases, the wound after the muscle and fascia are sutured is washed with ether poured freely into it, after which the layer of fat is rapidly shaven away as indicated.

Two interesting facts have been observed after the above procedure: 1st: there is practically no bleeding from the cut edges; 2nd: the cut edges adhere to each other immediately and securely. The fact that there is practically no bleeding after shaving the superficial fat indicates that the portion removed was poorly supplied with blood. The immediate and firm adhesion of the cut edges after shaving of the fat may be practically demonstrated, if one attempts to reopen a wound which has just been closed.

*Conclusions.*—While it cannot be stated that shaving the superficial fat will prevent fat necrosis in all cases, clinical experience in over five hundred cases demonstrates clearly that shaving of the superficial fat immediately previous to closing the skin will prevent fat necrosis in many instances, and therefore increase the number of primary unions in both clean and infected cases. The procedure is simple of execution and does not prolong or complicate the operation.

ANGELO L. SORESI, M.D.,  
New York City.

CORRESPONDENCE

ALUMINUM POTASSIUM NITRATE IN OSTEOMYELITIS

EDITOR ANNALS OF SURGERY:

Sir:

In the ANNALS OF SURGERY, for January, 1923, is an article which makes claims for a double synthetic salt of potassium and aluminum nitrate for use in osteomyelitis. I was instrumental in starting the treatment here in Chicago as far back as September, 1919, and with some colleagues treated several hundred cases. In fact I recognize one of the two pictures as the same used at that time.

I finally discovered the results, as far as I could tell, were the same whether the cases were treated with aluminum and potassium nitrate or potassium nitrate alone, and have given an account of my experience in the Medical Record, December 3, 1921. My belief is confirmed by the analysis made in the A. M. A. Chemical Laboratory, which showed only 2.5 per cent. of the aluminum nitrate.

J. RAWSON PENNINGTON, M.D.,  
*Chicago, Ill.*

To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

**ANNALS of SURGERY**  
227-231 S. 6th Street  
Philadelphia, Penna.

# INDEX TO VOLUME LXXVII

## A

- Abdominal Operations, The Significance of Diarrhœa Following, 524.  
 ABELL, IRVIN: Papilloma and Adenoma of Gall-bladder, 276.  
 Abscess, Brain, Its Surgical Pathology and Operative Technic, 508.  
 Abscess of the Lung, 370.  
 Actinomycosis Treated with Copper Sulphate, 618.  
 Adenoma and Papilloma of Gall-bladder, 276.  
 Adrenal, Congenital Hypertrophy of, 759.  
 Aluminum, Potassium Nitrate in Osteomyelitis, 784; In Suppurative Conditions, 38.  
 Anæsthesia, Colonic, 116.  
 Aneurism, Arteriovenous, 235; Ligation of Common Iliac with Fascial Strip for, 630; Popliteal Traumatic, 108; of the Thigh, 383.  
 Anthrax Infections, Treatment of, 263.  
 Appendix and Cæcum in Children, Sliding Hernias of, 438.  
 Appendix Versus the Ureter in Right-sided Abdominal Lesions, 638.  
 Aponeurosis, The Utilization of the External Oblique, in the Radical Cure of Inguinal Hernia, 605.  
 ARCHIBALD, EDWARD: The Surgical Treatment of Unilateral Pulmonary Tuberculosis, 652.  
 Arterial Decortication, 15.  
 Arteriovenous Aneurism, 235.  
 Artery, Thyroid, Ligation of the Inferior, 397.  
 Arthritis and Osteomyelitis, Suppurative, 497.  
 ASHHURST, A. P. C.: Empyema Thoracis, 249.  
 Aspiration Repeated in Traumatic Synovitis, 120.  
 AUCHINCLOSS, HUGH: Abscess of the Lung, 374; Pyoarthrosis of the Knee, 232; Tuberculosis of Chest Wall, 496; Suppurative Arthritis and Osteomyelitis, 497; Transplantation of Tendon, 499.

## B

- BAKER, JAMES N.: The Ureter Versus the Appendix in Right-sided Abdominal Lesions, 638.  
 BARTLETT, WILLARD: Factors of Safety in Thyroid Surgery, 685.  
 BATES, WILLIAM: Hæmolytic Jaundice, Treated by Blood Transfusions, 247.  
 BEER, EDWIN: Fistula Following Nephrectomy for Tuberculosis, 629; Intestinal Obstruction, Chronic Peritonitis and Multiple Serositis, 635; Multiple Bilateral Kidney Abscesses, 762; Splenectomy for Hæmolytic Jaundice, 764; Pyoarthrosis of the Knee, 233; Significance of Diarrhœa Following Abdominal Operations, 524.  
 Benign Tumors of the Stomach, 580.  
 Biceps Flexor Cubiti Tendon, Rupture of, 358.  
 BIDGOOD, CHARLES Y.: Traction Apparatus for Open Reduction of Fractures, 506.  
 Bile, White, in the Common Duct, 281.  
 Biliary Fistula, Chronic, 765.  
 Bladder, Spontaneous Intraperitoneal Rupture of the, 206.  
 BLAIR, VILRAY P.: Ranula, 681.  
 Blood Transfusion, 364, 503: Hæmolytic Jaundice, 247; Followed by Fatal Anaphylactic Reaction, 761.  
 BLOODGOOD, JOSEPH COLT: Bone Tumors, Metastasis to Lungs from a Pure Myxoma, 106.  
 BOLAND, FRANK K.: Spontaneous Hæmatoma in Sarcoma of Kidney, 311.  
 Bone, Frontal, Fracture of, Transplantation of Costal Cartilages for, 115.  
 Bone Graft in Spastic Paralysis, Stabilization of Wrist Joint by, 246.  
 Bone Tumors, Metastasis of Myxoma to Lungs, 106.  
 Bones and Joints, Heliotherapy for Tuberculosis of, 620.  
 Brain Abscess, Its Surgical Pathology and Operative Technic. By Wells P. Eagleton, 508.

## INDEX

Brain Tumors, Operative Removal of, 769.  
 Breast, Teratoid Mixed Tumors of the, 354; Tuberculosis of the, 661; Tumors of the, Innocent and Malignant, 668.  
 BROWN, HENRY P., JR., Empyema Thoracis, 249; Empyema Thoracis, 401.  
 Bucknall's Operation, for Hypospadias, Modification of, 572.  
 BURDICK, CARL G.: Fractures of the Femur in Children, 736.

### C

Cæcum and Appendix in Children, Sliding Hernias of 438.  
 Cæcum, Involvement of the Lymph Glands in Cancer of the, 698.  
 Calculous Cast of Prostate, 381.  
 Calculi, Urinary, The Mechanism of the Formation of the, 210.  
 CALLANDER, C. LATIMER: Arterial Decortication, 15.  
 Cancer of the Cæcum, Involvement of the Lymph Glands, in, 698; of the Larynx, 1; of Prostate, 628; of the Rectum and Sigmoid in Childhood and Adolescence, 711.  
 Carcinoma, Colloid, 90; Œsophagus, Metastases of, 272.  
 Cardiospasm in the Aged, 615.  
 CARTER, BURR N.: Traction Apparatus for Open Reduction of Fractures, 506.  
 Cartilages of the Knee-Joint, Non-operative Treatment of Displaced Semilunar, 729.  
 Cartilage, Transplant of Costal in Rhinoplasty, 116.  
 CHARLTON, PAUL H.: Sarcoma of the Uterus, 476.  
 Chest Wall, Tuberculosis of, 496.  
 Cholangitis, Cholelithiasis and Cholecystitis, 52.  
 Cholecystectomy versus Cholecystostomy, 48.  
 Cholecystitis, Cholangitis and Cholelithiasis, 52.  
 Cholecystostomy versus Cholecystectomy, 48.  
 Cholelithiasis, Cholecystitis and Cholangitis, 52.  
 Clavicle, Sarcoma of the, 778.  
 COLE, WILLIAM: Hyperthyroidism with Associated Diabetes Mellitus, 252.

Colitis, Surgical Treatment of Chronic Ulcerative, 293.  
 Colloid Carcinoma, 90.  
 Colonic Anæsthesia, 116.  
 Costal Cartilages, Transplantation of, for Depressed Fracture of Frontal Bone, 115.  
 CONNORS, JOHN F.: Diverticulitis of Stomach, 233; Arteriovenous Aneurism, 235; Congenital Diaphragmatic Hernia, 725.  
 COPHER, GLOVER H.: Sarcoma of the Omentum, 721.  
 CRAIG, WINCHELL MCK.: Involvement of the Lymph Glands in Cancer of the Cæcum, 698.  
 Cyst, Echinococcus, of Liver, 634; of Liver Solitary, 237; Retention, Removal of a, from the Liver, 68.

### D

DAVID, VERNON C.: Sliding Hernias of Cæcum and Appendix in Children, 438.  
 DAVIS, JOHN STAIGE: General Plastic Surgery, 257.  
 Decortication, Arterial, 15.  
 DECOURCY, JOSEPH L.: Ligation of the Inferior Thyroid Artery, 397.  
 DESPARD, D. L.: Empyema Thoracis, 251; Hæmolytic Jaundice, 249.  
 Diabetes Mellitus, Hyperthyroidism with Associated, 252.  
 Diaphragmatic Hernia, Congenital, 725.  
 Diarrhoea Following Abdominal Operations, 524.  
 Dislocation, Anterior, at the Elbow Joint, 612.  
 Dislocation, Recurrent, of Shoulder, 118.  
 Diverticulitis of Stomach, 233.  
 Diverticulum of the Œsophagus, Treatment of, 267; Perforated Meckel's, 622.  
 DORRANCE, GEORGE M.: Heliotherapy for Tuberculosis of Bones and Joints, 622; Hæmolytic Jaundice, 249.  
 DOUGLAS, BEVERLY: Skin Grafting by Exact Pattern, 223.  
 DOUGLAS, JOHN: Benign Tumors of the Stomach, 580; Ligation of Common Iliac with Fascial Strip for Aneurism, 630; Stricture of the Common Biliary Duct, 768; Perforated Duodenal Ulcer and Bleeding Jejunal Ulcer, 754; Perforated Duodenal Ulcer, 755.

# INDEX

DOWD, CHARLES N.: Tuberculous Peritonitis, 632; Echinococcus Cyst of Liver, 634; Intussusception in Adult, Due to Adenoma in Ileum, 633; Relationship Between Intestinal Obstruction, Chronic Peritonitis and Chronic Multiple Serositis, 423.

DOWNES, WILLIAM A.: Hypernephroma of Ovary in a Child, 758; Injuries to the Common Biliary Duct, 767; Perforated Duodenal Ulcer in a Child, 756.

Drainage in Intraabdominal Infection, 558.

Duct, Common, White Bile in the, 281.

Duodenal Ulcer, Perforated 754 and 755. Perforated, in a Child, 756.

Duodenum and Stomach, Recurring Perforations of, 108.

## E

EAGLETON, WELLS, P.: Brain Abscess, Its Surgical Pathology and Operative Technic, 508.

Echinococcus Cyst of Liver, 634.

EGGERS, CARL: Chronic Empyema, 142; Radical Operation for Chronic Empyema, 327 and 375.

EISENDRATH, DANIEL N.: Double Kidney, 450, 531.

Elbow Joint, Anterior Dislocation at the, 612.

ELIASON, E. L.: Subacute Massive Proctitis, 625.

ELIOT, ELLSWORTH, JR.: Removal of Appendix in a Case of Tuberculosis in the Peritoneum, 637.

ELKIN, DAN COLLIER: Tuberculosis of the Breast, 661.

ELSBERG, CHARLES A.: Operative Removal of Brain Tumors, 769.

Embryoma or Sarcoma of the Kidney in Infants, 306.

Empyema, Atypical Chronic, 375; Chronic, 142, 241; Chronic, Radical Operation for, 327 and 375; Thoracic, 249, 401.

Epiphysis of Tibia, Separation of Upper, 485.

ERDMANN, JOHN F.: Sarcoma of the Clavicle, 778.

ERDMAN, SEWARD: Inguinal Hernia in the Male, 171; Transplantation of Tendon; 503.

## F

FARR, CHARLES E.: Ischæmic Fat Necrosis, 513.

Fascial Strip, Use of, for Arterial Ligations, 630.

Fat Necrosis, Ischæmic, 779; in Incisions, Prevention of, 782.

Femur, Abduction Treatment for Fracture of Neck of, 127, in Children, Fractures of the, 736; Pathological Fracture of the Neck of the, Due to Thyroid Metastases, 689.

FISCHER, HERMANN: Immediate Feeding after Resection of Stomach, 773; Primary Ulcer of the Jejunum, 775.

Fistula, Chronic Biliary, 765; Gastrocolic, 433; Pulmonary Lip, 777.

Foot, Radium Burn of, 628.

Fracture-dislocation of Lumbar Vertebrae, 243.

Fracture of Femur, Traction Treatment of, 239; of the Femur in Children, 736; Pathological, of the Neck of the Femur, Due to Thyroid Metastases, 689; of the Skull, 624.

Fractures, Multiple, of the Pelvis, 623; Spiral, 252; Traction Apparatus for Open Reduction of, 506.

FREEMAN, LEONARD: Improved Technic for Gastrectomy and Gastro-enterostomy, 190.

## G

Gall-bladder Disease in Childhood, 587; Papilloma and Adenoma of, 276; Surgery of the, 64.

Gasserian Ganglion, Priority in Extirpation of, 125.

Gastrectomy and Gastro-enterostomy, Improved Technic for, 190.

Gastro-colic Fistula, 433.

Gastro-enterostomy and Gastrectomy, Improved Technic for, 190.

Gastro-jejunostomy for Perforated Gastric and Duodenal Ulcers, 254.

GEISINGER, JOSEPH F.: Reduplication of the Ureter, 563; Spontaneous Intra-peritoneal Rupture of the Bladder, 206.

GIBBON, JOHN: Biliary Fistula, 767; Perforated Duodenal Ulcer in a Child, 757.

GIBSON, ALEXANDER: Separation of Upper Epiphysis of Tibia, 485.

## INDEX

GILL, A. BRUCE: Heliotherapy for Tuberculosis of Bones and Joints, 620.  
Glands, Involvement of the Lymph, in Cancer of the Cæcum, 698.  
Gonococcus Myositis, 782.  
Grafting, Skin, by Exact Pattern, 223.  
GRAHAM, DOUGLAS: Non-operative Treatment of Displaced Semilunar Cartilages of the Knee-joint, 729.  
GREEN, NATHAN W.: Abscess of the Lung, 370; Radical Operation for Chronic Empyema, 375.  
GUTHRIE, DONALD: Practical Hospital Psychology, 112.

### H

Hæmatoma, Spontaneous, in Sarcoma of Kidney, 311.  
Hæmolytic Jaundice, Treated by Blood Transfusions, 247.  
HALLAHAN, ROBERT E.: Treatment of Traumatic Synovitis, 781.  
HARTWELL, JOHN A.: Traumatic Arthrosis, 232; Radical Operation for Chronic Empyema, 380; Recurrent Dislocation of Shoulder, 118. Colonic Anæsthesia, 116.  
HARVEY, SAMUEL CLARK: A Modification of the Operation of Bucknall for Hypospadias, 572; The Regeneration of the Meninges, 129.  
Heliotherapy for Tuberculosis of Bones and Joints, 620.  
HELSLEY, GORDON F.: Metastases of Oesophagus Carcinoma, 272.  
Hernia, Congenital Diaphragmatic, 725; Inguinal, Radical Cure of, 605; Inguinal, in the Male, 171; Massive Ventral, 445.  
Hernias, Sliding, of Cæcum and Appendix in Children, 438.  
HEYD, CHARLES G.: Blood Transfusion, 504; Relationship Between Intestinal Obstruction, Chronic Peritonitis and Multiple Serositis, 636.  
HODGE, EDWARD B.: Empyema Thoracis, 250.  
Hospital Psychology, Practical, 112.  
Humerus, Intrauterine, Sarcoma of, 771.  
Hypernephroma of Ovary in a Child, 758.  
Hyperthyroidism with Associated Diabetes Mellitus, 252.  
Hypospadias, A Modification of the Operation of Bucknall for, 572.

### I

Ileum, Intussusception in Adult, Due to Adenoma in, 633.  
Ileus, Combination, 594.  
Iliac Artery, Common, Ligation of, with Fascial Strip for Aneurism, 630.  
ILLOWAY, HENRY: Priority in the Extirpation of the Gasserian Ganglion, 125.  
Infection, Intraabdominal Drainage in, 558.  
Inguinal Hernia in the Male, 171.  
Inguinal Hernia, Radical Cure of, 605.  
Intestinal Obstruction, Chronic Peritonitis and Chronic Multiple Serositis, Relationship Between, 423; Due to Chronic Peritonitis, 635.  
Intestinal Occlusions, The Coincidence of Two, 594.  
Intraabdominal Infection, Drainage in, 558.  
Intraperitoneal Rupture, Spontaneous, of the Bladder, 206.  
Intussusception in Adult, due to Adenoma in Ileum, 633.  
Ischæmic Fat Necrosis, 513.  
IVY, ROBERT H.: Actinomycosis Treated with Copper Sulphate, 618.

### J

JACKSON, CHEVALIER: Cancer of the Larynx, 1.  
Jaundice, Hæmolytic, Treated by Blood Transfusions, 247; Splenectomy for, 764.  
Jejunal Ulcer, Bleeding and Perforated Duodenal Ulcer, 754.  
Jejunum, Primary Ulcer of the, 775.  
Joint, Anterior Dislocation of the Elbow, 612.  
JONES, JOHN F. X.: Removal of a Retention Cyst from the Liver, 68.  
JOPSON, JOHN H.: Biliary Fistula, 766; Hæmolytic Jaundice, 249; Empyema Thoracis, 250; Ochsner Treatment in Peritonitis, 194; Perforating Wound of Kidney with Secondary Nephrectomy, 110; Volkmann's Contracture, 244.  
JUDD, E. STARR: White Bile in the Common Duct, 281.

### K

KEILLER, V. H.: Lymphangioma of the Neck, 385.

# INDEX

KELLOGG, EDWARD LELAND: Gall-bladder Disease in Childhood, 587.  
 KEYES, A. BELCHAM: Cholelithiasis Cholecystitis and Cholangitis, 52.  
 KEYSER, LINWOOD D.: The Mechanism of the Formation of Urinary Calculi, 210.  
 Kidney Abscesses, Multiple Bilateral, 762.  
 Kidney, Double, 450, 531; Perforating Wound of, with Secondary Nephrectomy, 110; Sarcoma and Embryoma of the, in Infants, 306; Spontaneous Hæmatoma in Sarcoma of, 311.  
 KLEINBERG, S.: Spondylolisthesis, 490.  
 Knee-joint, Non-operative Treatment of Displaced Semilunar Cartilages of the, 729; Pyoarthrosis of the, 230.

## L

LAHEY, FRANK H.: Transplantation of Common Duct Fistula into Duodenum, 767.  
 LAMSON, OTIS F.: Certain Aspects of Surgery of the Gall-bladder, 64.  
 Larynx, Cancer of the, 1.  
 LAWS, GEORGE M.: Hæmolytic Jaundice, Treated by Blood Transfusions, 247.  
 LEE, BURTON, J.: Traumatic Fat Necrosis, 779.  
 LEE, W. E.: Fatal Reaction After Blood Transfusion, 761.  
 LEHMAN, EDWIN P.: Peri-arterial Sympathectomy, 30.  
 LEWISOHN, RICHARD: Blood Transfusion, 503; Resection of Stomach for Ulcer, 774.  
 LILIENTHAL, HOWARD: Abscess of the Lung, 373; Bilateral Multiple Kidney Abscesses, 763; Chronic Biliary Fistula, 765; Extrapleural Thoracoplasty for Pulmonary Tuberculosis, 630; Radical Operation for Chronic Empyema, 379; Relationship Between Intestinal Obstruction, Chronic Peritonitis and Multiple Serositis, 636.  
 Limbs, Artificial and Amputation Stumps. By E. Muirhead Little, 511.  
 Liver, Echinococcus Cyst of, 634; Removal of a Retention Cyst from the, 68; Solitary Cyst of, 237.  
 LUDINGTON, NELSON AMOS: Rupture of Biceps Flexor Cubiti Tendon, 358.  
 Lumbar Vertebrae, Fracture-dislocation of, 243.  
 Lung, Abscess of the, 370.  
 LYLE, H. H. M.: Radical Operation for Chronic Empyema, 380; Relationship Between Intestinal Obstruction, Chronic Peritonitis and Multiple Serositis, 636.  
 Lymphangioma of the Neck, 385.  
 LYONS, JOHN H.: White Bile in the Common Duct, 281.

## M

MACCARTY, WILLIAM CARPENTER: Involvement of the Lymph Glands in Cancer of the Cæcum, 698.  
 MANN, FRANK C.: Experimental Production of Peptic Ulcer, 409.  
 MASLAND, HARVEY C.: A Power-Driven To-and-Fro Saw, 122.  
 MATTHEWS FRANK S.: Myeloma of Clavicle, 778.  
 MAURY, JOHN M.: Ureteral Injuries During Pelvic Operations, 314.  
 MAYO, CHARLES H.: Treatment of Diverticulum of the Oesophagus, 267.  
 MCGLANNAN, ALEXIUS: Treatment of Anthrax Infections, 263.  
 McIVER, MONROE ANDERSON: Teratoid Mixed Tumors of the Breast, 354.  
 McKNIGHT, H. A.: Multiple Fractures of the Pelvis, 623; Fracture of the Skull, 624; Perforating Wound of Kidney with Secondary Nephrectomy, 110; Recurring Perforations of Stomach and Duodenum 108.  
 McWILLIAMS, CLARENCE A.: Complete Rhinoplasty by Cartilage Transplant and Pedicled Temporal Forehead Flap, 116; The Efficient Treatment of Acute and Chronic, Simple, Traumatic Synovitis, by Repeated Aspirations and Immediate Active Mobilizations without Splinting, 120; Suppurative Arthritis and Osteomyelitis, 499; Transplantation of Costal Cartilages for Depressed Fracture of Frontal Bone, 115.  
 Meckel's Diverticulum, Perforated, 622.  
 Meninges, The Regeneration of the, 129.  
 MERRILL, WILLIAM JACKSON: Stabilization of Wrist Joint by Bone Graft in Spastic Paralysis, 246.  
 Mesenteric Thrombosis, 299.  
 Metastases of Oesophagus Carcinoma, 272.

## INDEX

- Metastases, Thyroid, Pathological Fracture of the Neck of the Femur, Due to, 689.
- MEYER, WILLY: Abscess of the Lung, 373. Atypical Chronic Empyema, 375; Cancer of Prostate, 628; Radium Burn of Foot, 628; Fistula Following Nephrectomy for Tuberculosis, 629; Extra-pleural Thoracoplasty for Pulmonary Tuberculosis, 630; Pulmonary Lip-fistula, 777; Radical Operation for Chronic Empyema, 380.
- MITCHELL, JAMES F.: Mesenteric Thrombosis, 299.
- MORRIS, ROBERT T.: Treatment of Traumatic Synovitis, 120.
- MOSCHCOWITZ, ALEXIS V.: Biliary Fistula, 768; Prolapse of the Rectum, Operation for, 770.
- MULLER, GEORGE P.: Carcinoma of the Rectum, 626; Perforated Duodenal Ulcer in a Child, 757; Stricture of the Common Biliary Duct, 768; Results of Operation for Prolapse of the Rectum, 770; Sepsis After Tonsillectomy, 761; Surgical Relations of the Sympathetic Nervous System, 641.
- Myositis, Gonococcus, 782.
- Myxoma, Metastasis to Lungs of a, 106.
- ### N
- Neck, Lymphangioma of the, 385.
- Necrosis, Ischaemic Fat, 513.
- Nephrectomy, Secondary in Perforating Wound of Kidney, 110; For Tuberculosis, Fistula Following, 629.
- Nervous System, Sympathetic, Surgical Relations of the, 641.
- NEUHOF, HAROLD: Transplantation of Toe, 228; Pyoarthrosis of the Knee, 230.
- NEW YORK SURGICAL SOCIETY: Transactions of the, 115, 228, 370, 628, 754, 771.
- ### O
- Ochsner Treatment in Peritonitis, 194.
- O'CONOR, SIR JOHN: Operating Rooms and Body Warmth of Patients, 123; Gastro-jejunostomy for Perforated Gastric and Duodenal Ulcers, 254.
- O'DAY, J. CHRISTOPHER: Cholecystostomy versus Cholecystectomy, 48.
- Oesophagus Carcinoma, Metastases of, 272.
- Oesophagus, Treatment of Diverticulum of the, 267.
- Omentum, Sarcoma of the, 721.
- Operating Rooms, 123.
- Osteomyelitis and Arthritis, Suppurative, 497; Treatment of, with Aluminum-Potassium Nitrate, 38, 784; Typhoidal, 319; Ovary, Hypernephroma of, in a Child, 758.
- OWEN, HUBLEY R.: Traumatic Popliteal Aneurism, 108
- ### P
- Papilloma and Adenoma of Gall-bladder, 276.
- Paralysis, Spastic, Stabilization of Wrist Joint by Bone Graft in, 246.
- PARHAM, DUNCAN: Colloid Carcinoma, 90.
- PECK, CHARLES H.: Abscesses of Kidney, 763; Splenectomy in Hæmolytic Jaundice, 765.
- Pelvic Operations, Ureteral Injuries During, 314.
- Pelvis, Multiple Fractures of the, 623.
- PENNINGTON, J. RAWSON: Aluminum-Potassium Nitrate in Osteomyelitis, 784.
- PEPPER, O. H. P.: Hæmolytic Jaundice of the Hayem Widai Type, 248.
- Peptic Ulcer, Experimental Production of, 409.
- Perforations, Recurring, of Stomach and Duodenum, 108.
- Peri-arterial Sympathectomy, 30.
- Pericarditis, Suppurative, 236.
- Peritonitis, Chronic, Causing Intestinal Obstruction, 635; Intestinal Obstruction and Chronic Multiple Serositis, Relationship Between, 423; Ochsner, Treatment in, 194; Tuberculous, 632.
- PETERSON, EDWARD W.: Blood Transfusion, 364, 503; Sepsis Following Tonsillectomy, 760; Suppurative Pericarditis, 236; Solitary Cyst of Liver, 237.
- PFEIFFER, DAMON B.: Ochsner Treatment in Peritonitis, 194; Perforated Meckel's Diverticulum, 622; Subacute Massive Proctitis, 626.
- PHIFER, CHARLES HERBERT: Cancer of the Rectum and Sigmoid in Childhood and Adolescence, 711.



# INDEX

## PHILADELPHIA ACADEMY OF SURGERY:

- Transactions of the, 108, 228, 618, 754.  
 Plastic Surgery, General, 257.  
 PAUL, EUGENE H.: Gastro-enterostomy in Cases of Perforated Duodenal Ulcer, 757.  
 Popliteal Traumatic Aneurism, 108.  
 PRATT, GEORGE P.: Gastro-colic Fistula, 433.  
 PRIMROSE, ALEXANDER: Tumors of the Breast, Innocent and Malignant, 668.  
 Proctitis, Subacute Massive, 625.  
 Prostate, Cancer of, 628; Calculous Cast of, 381.  
 Psychology, Practical Hospital, 112.  
 Pulmonary Lip-fistula, 777.  
 Pulmonary Tuberculosis, Unilateral, The Surgical Treatment of, 652.  
 Pyoarthritis of the Knee, 230.

## R

- Radium Burn of Foot, 628.  
 Ranula, 681.  
 Rectum and Sigmoid, Cancer of the, In Childhood and Adolescence, 711.  
 Rectum Prolapsed, Operation for, 770.  
 Rectus Muscle, Transposition of the, In the Radical Cure of Inguinal Hernia, 605.  
 Reduplication of the Ureter, 563.  
 REEL, PHILIP J.: Sarcoma of the Uterus, 476.  
 Rhinoplasty by Cartilage Transplant and Pedicled Temporal Forehead Flap, 116.  
 RIXFORD, EMMET: Spiral Fractures, 252.  
 ROBERTS, JOHN B.: Empyema Thoracis, 250.  
 ROBINS, CHARLES R.: Sarcoma and Embryoma of the Kidney in Infants, 306.  
 ROBINSON, WILLIAM T.: Congenital Diaphragmatic Hernia, 725.  
 RODMAN, J. S.: Empyema Thoracis, 251; Operative Removal of Brain Tumors, 770.  
 ROTHSCHILD, NORMAN S.: Chronic Empyema, 241.  
 Rupture of Biceps Flexor Cubiti Tendon, 358; Spontaneous Intraperitoneal, of the Bladder, 206.  
 RYAN WILLIAM JOHN: Intrauterine Sarcoma of Humerus, 771.

## S

- Sarcoma of Clavicle, 778; or Embryoma of the Kidney in Infants, 306; of Kidney, Spontaneous Hæmatoma in, 311; of the Omentum, 721; of the Uterus, 476.  
 Saw, Power-Driven To-and-Fro, 122.  
 SAYAD, WILLIAM Y.: The Regeneration of the Meninges, 129.  
 SCHLAEFFER, KARL: Combination Ileus, or the Coincidence of Two Intestinal Occlusions, 594.  
 SCHLEY, WINFIELD SCOTT: Transposition of the Rectus Muscle and the Utilization of the External Oblique Aponeurosis in the Radical Cure of Inguinal Hernia, 605.  
 Semilunar Cartilages, Displaced, of the Knee-joint, Non-operative Treatment of, 729.  
 Serositis, Chronic Multiple, Relationship Between Intestinal Obstruction, Chronic Peritonitis and, 423.  
 Serositis, Multiple, 635.  
 SHERWOOD, WALTER A.: Intrauterine Periosteal Sarcoma of the Humerus 771.  
 Shoulder, Recurrent Dislocation of, 118.  
 Sigmoid and Rectum, Cancer of the, In Childhood and Adolescence, 711.  
 SIRIS, IRWIN E.: Fractures of the Femur in Children, 736.  
 Skin Grafting by Exact Pattern, 223.  
 Skull, Fracture of the, 624.  
 SORESI, ANGELO, L.: Prevention of Fat Necrosis in Incisions, 782.  
 SPEESE, JOHN: Congenital Bilateral Hyperplasia of Adrenals, 759.  
 Spleen, Stab Wound of, 370.  
 Splenectomy for Hæmolytic Jaundice, 764.  
 Spondylolisthesis, 490.  
 STETTEN, DEWITT: Calculous Cast of Prostate, 381; Resection of Stomach for Ulcer, 774; Traumatic Fat Necrosis, 779; Stab Wound of Spleen, 370.  
 Stomach, Benign Tumors of the, 580; and Duodenum, Recurring Perforations of, 108; Diverticulitis of, 233; Resection of, Immediate Feeding After, 773.  
 STONE, HARVEY B.: Surgical Treatment of Chronic Ulcerative Colitis, 293.  
 Stumps, Amputation and Artificial Limbs. By E. Muirhead Little, 511.

## INDEX

Surgery, General Plastic, 257.  
 Surgery of the Gall-bladder, 64.  
 Surgical Treatment of Chronic Ulcerative Colitis, 293.  
 Suppurative Pericarditis, 236.  
 Suspension and Traction Treatment of Fractures, 238.  
 SUTTON, IRWIN C.: Hyperthyroidism with Associated Diabetes Mellitus, 252.  
 Sympathectomy, Peri-arterial, 30.  
 Sympathetic Nervous System, Surgical Relations of, 641.  
 Synovitis, Traumatic, The Treatment of Acute and Chronic, 120, 781.

### T

TEES, FREDERICK J.: Anterior Dislocation of the Elbow Joint, 612.  
 Tendon, Transplantation of, 499.  
 Teratoid Mixed Tumors of the Breast, 354.  
 Thigh, Aneurism of the, 383.  
 THOMAS, T. TURNER: Empyema Thoracis, 250.  
 THOMPSON, JAMES E.: Lymphangioma of the Neck, 385.  
 Thoracis, Empyema, 249, 401.  
 Thoracoplasty, Extrapleural for Pulmonary Tuberculosis, 630.  
 THOREK, MAX: Aluminum-Potassium Nitrate in the Treatment of Suppurative Conditions, Particularly Osteomyelitis, 38.  
 Thrombosis, Mesenteric, 299.  
 Thyroid Artery, Ligation of the Inferior, 397.  
 Thyroid Metastases, Pathological Fracture of the Neck of the Femur, Due to, 689.  
 Thyroid Surgery, Factors of Safety in, 685.  
 Tibia, Separation of Upper Epiphysis of, 485.  
 Toe, Transplantation of, 228.  
 Tonsillectomy, with Septic Sequelæ, 760.  
 TORRANCE, GASTON: Aneurism of the Thigh, 383.  
 Traction and Suspension Treatment of Fractures, 238.  
 Transfusion, Blood, 364, 503.  
 Traumatic Popliteal Aneurism, 108.  
 Traumatic Synovitis, The Treatment of Acute and Chronic, 120.

Tuberculosis of Bones and Joints, Heliotherapy for, 620; of the Breast, 661; of Chest Wall, 496; Fistula Following Nephrectomy for, 629; Pulmonary, Extrapleural Thoracoplasty for, 630; Unilateral Pulmonary, The Surgical Treatment of, 652.  
 Tuberculous Peritonitis, 632.  
 Tumors, Bone, Metastasis to Lungs from a Pure Myxoma, 106.  
 Tumors of the Breast, Innocent and Malignant, 668; Benign, of the Stomach, 580; Teratoid Mixed, of the Breast, 354.  
 Typhoidal Osteomyelitis, 319.

### U

Ulcer, Peptic, Experimental Production of 409, Perforated Duodenal, in a Child, 756; Perforated Duodenal and Bleeding Jejunal Ulcer, 754.  
 Ulcers, Gastro-jejunostomy for Perforated Gastric and Duodenal, 254.  
 Unilateral Pulmonary Tuberculosis, The Surgical Treatment of, 652.  
 Ureter Versus the Appendix in Right-sided Abdominal Lesions, 638.  
 Ureter, Reduplication of the, 563.  
 Ureteral Injuries during Pelvic Operations, 314.  
 Urinary Calculi, The Mechanism of the Formation of the, 210.  
 Uterus, Sarcoma of the, 476.

### V

Ventral Massive Hernia, 445.  
 Vertebrae, Lumbar, Fracture-dislocation of, 243.  
 Volkmann's Contracture, 244.  
 VILLARS, HORACE S: Massive Ventral Hernia, 445.

### W

WARE, MARTIN A.: Gonococcus Myositis, 782.  
 WHIPPLE, ALLEN O.: Pyoarthrosis of the Knee, 232; Tuberculosis of Chest Wall, 497.  
 White Bile in the Common Duct, 281.

## INDEX

- WIENER, JOSEPH: Cure of Sinuses by X-ray, 629.
- WILENSKY, ABRAHAM O.: Drainage in Intraabdominal Infection, 558.
- WILLIAMSON, CARL S.: Experimental Production of Peptic Ulcer, 409.
- WINSLOW, NATHAN: Typhoidal Osteomyelitis, 319.
- WHITMAN, ROYAL: Pyoarthrosis of the Knee, 232; Treatment of Traumatic Synovitis, 120; The Essential Feature of the Abduction Treatment for Fracture of the Neck of the Femur, 127; Suppurative Arthritis and Osteomyelitis, 499; Treatment of Fracture of the Neck of the Femur by Traction, 239.
- WOLFE, JOHN B.: Fracture-dislocation of Lumbar Vertebrae, 243.
- WOOLSEY, GEORGE: Treatment of Traumatic Synovitis, 120.
- Wrist Joint, Stabilization of, by Bone Graft in Spastic Paralysis, 246.

### Z

- ZAAIJER, J. H.: Cardiospasm in the Aged, 615.
- ZADEK, ISADORE: Pathological Fracture of the Neck of the Femur, due to Thyroid Metastases, 689.



# Eastman Prepared X-Ray Developer *and* Fixing Powders

will standardize dark-room  
technique—will promote:



*Efficiency*

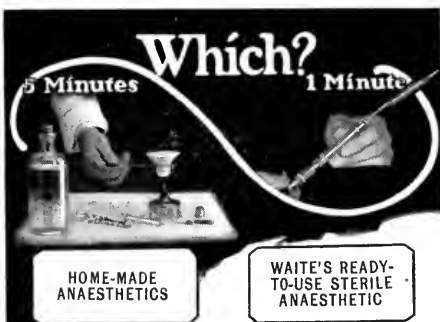
*Uniformity*

*Economy*

Eastman Kodak Company

*Medical Division*

Rochester, N. Y.



## Waite's ANTISEPTIC LOCAL ANAESTHETIC (2% Procaine or 1% Cocaine) **In Ampules!**

Your time is too valuable to bother with boiling water and making anaesthetic, while the preparation of an anaesthetic is too important to be left to an assistant.

Anaesthetic made with distilled water is seldom sterile, or free from foreign substances which are likely to cause soreness.

The boiling of such anaesthetic makes it sterile only for the instant, while evaporation changes it from an isotonic solution to a hypertonic solution that may cause serious after-pains.

To be sure of a sterile anaesthetic, use Waite's Antiseptic Local Anaesthetic In Ampules. Unlike ordinary procaine solution, its antiseptic base keeps it sterile when opened and while being used.

**Waite's Anaesthetic is also sold in bottles.**

**\$1.00 box for 25c**

To introduce Waite's Antiseptic Local Anaesthetic we will send you once only, \$1.00 box on receipt of your professional card or letterhead and 25c, or if you prefer a free sample for your professional card or letter head only.

**For sale by physician supply houses and dental depots.**

ANTIDOLOR MFG. CO.  
4 MAIN ST., SPRINGVILLE,  
ERIE CO., N. Y., U. S. A.

**Sign and Mail this Coupon**

ANTIDOLOR MFG. CO.,  
Springville, Erie Co., N. Y., U. S. A.

Enclosed find professional card and 25c. Please send me \$1.00 box of Waite's Antiseptic Local Anaesthetic. I have never taken advantage of this offer before.

Enclosed find professional card. Please send one free sample of Waite's Antiseptic Local Anaesthetic.

NAME.....

ADDRESS.....

## The WALKESAY ARTIFICIAL LEG



Our Art Catalog contains valuable information on Care and Treatment of Stump Preparatory to Applying an Art Limb. How Soon to Apply. Art Limbs for Children. Directions for Self-Measurement, etc., etc.

**GEORGE R. FULLER CO., ROCHESTER, N. Y.**  
Branches, Buffalo, Boston, Philadelphia



## YOUR X-RAY SUPPLIES

**Get our price list and discounts on quantities before you purchase**

**HUNDREDS OF DOCTORS FIND WE SAVE THEM FROM 10% TO 25% ON X-RAY LABORATORY COSTS**

**AMONG THE MANY ARTICLES SOLD ARE**

**X-RAY PLATES.** Three brands in stock for quick shipment. PARAGON Brand, for finest work, UNIVERSAL Brand, where price is important.

**X-RAY FILMS.** Duplitzed or Dental—all standard sizes. Eastman, Ilford or X-ograph metal backed. Fast or slow emulsion.

**BARIUM SULPHATE.** For stomach work. Finest grade. Low prices.

**COOLIDGE X-RAY TUBES.** 5 styles. 10 or 30 milliamp. Radiator (small bulb) or broad, medium or fine focus, large bulb. Lead Glass Shields for Radiator type.

**DEVELOPING TANKS.** 4 or 6 compartment, stone, will end your dark room troubles. 5 sizes of Enamelled Steel Tanks.

**DENTAL FILM MOUNTS.** Black or gray cardboard with celluloid window or all celluloid type, one to eleven film openings. Special list and samples on request. Price includes imprinting name and address.

**DEVELOPER CHEMICALS.** Metol, Hydroquinone, Hypo, etc.

**INTENSIFYING SCREENS.** Patterson, TE, or celluloid-backed screens. Reduce exposure to 1/4th or less. Double screens for film. All-metal cassettes.

**LEADED GLOVES AND APRONS.** (New type glove, lower priced.)

**FILING ENVELOPES** with printed X-ray form. (For used plates.) Order direct or through your dealer.



**If You Have a Machine Get Your Name on Our Mailing List**

**GEO. W. BRADY & CO.**  
757 So. Western Ave. CHICAGO

1910

1922



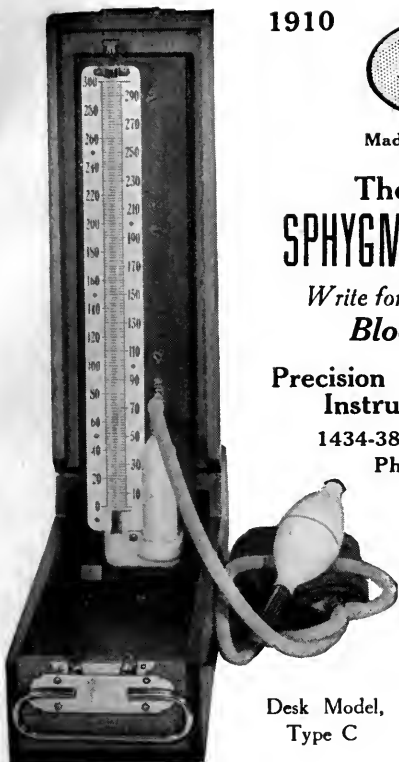
Made in Philadelphia

## The MASTER SPHYGMOMANOMETERS

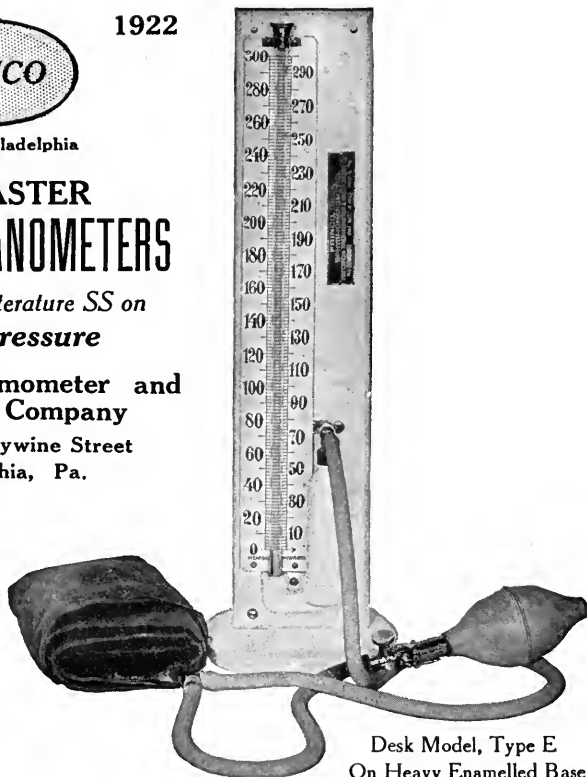
*Write for our literature SS on  
Blood Pressure*

**Precision Thermometer and  
Instrument Company**

1434-38 Brandywine Street  
Philadelphia, Pa.



Desk Model,  
Type C



Desk Model, Type E  
On Heavy Enamelled Base



# LISTERINE

*A Non-Poisonous, Unirritating, Antiseptic Solution*

Agreeable and satisfactory alike to the Physician, Surgeon, Nurse and Patient. Listerine has a wide field of usefulness and its unvarying quality assures like results under like conditions.

- As a wash and dressing for wounds
- As a deodorizing, antiseptic lotion
- As a gargle
- As a mouth-wash dentifrice

Operative or accidental wounds heal rapidly under a Listerine dressing, as its action does not interfere with the natural reparative processes.

The freedom of Listerine from possibility of poisonous effect is a distinct advantage, and especially so when the preparation is prescribed for employment in the home.

**LAMBERT PHARMACAL COMPANY**

SAINT LOUIS, MO., U. S. A.

# TELEPHONE YOUR DEALER



for D. R. L.

## Neoarsphenamine

This superior product is characterized by:

- 1—**PURITY**—freedom from reaction.
- 2—**HIGH Chemo-Therapeutic index**—proven by clinical results.
- 3—**EASE** of solubility—simplicity in preparing solutions.
- 4—**WIDE** margin of safety due to intensive research and improved methods of production.

INSIST UPON  
*Safety First—Quality Always*

THIS MEANS D. R. L.

For the convenience of physicians D. R. L. Neoarsphenamine is supplied by dealers in bulk packages containing 10 ampules of the drug in one size (.9 gram, .75, .6 or .45 gram as ordered) and 10 ampules of double distilled water in hard glass ampules.

*No extra charge is made for the distilled water in bulk packages*

THE DERMATOLOGICAL RESEARCH LABORATORIES

1720-1726 Lombard Street; Philadelphia

THE ABBOTT LABORATORIES

4753 Ravenswood Ave.

CHICAGO

New York San Francisco Seattle Los Angeles



## Anusol-Hemorrhoidal-Suppositories

*Often Obviate Operation*

**Anusol Suppositories**

(Trade Mark)

The preferred prescription in Hemorrhoids and allied rectal affections for more than a quarter century, are produced in our plant at Bloomfield, N. J.

When supplied in the U. S. A., they can be relied upon as *standard* and *genuine* only if the name

*"SCHERING & GLATZ, INC."*

is found on label and seal band and the latter is intact.

*Obtainable from any up-to-date Druggist*

Complimentary Trial  
Quantity from

**Schering & Glatz**  
(Incorporated)

150-152 Maiden Lane  
NEW YORK



Furnished in  
boxes of 12  
Suppositories





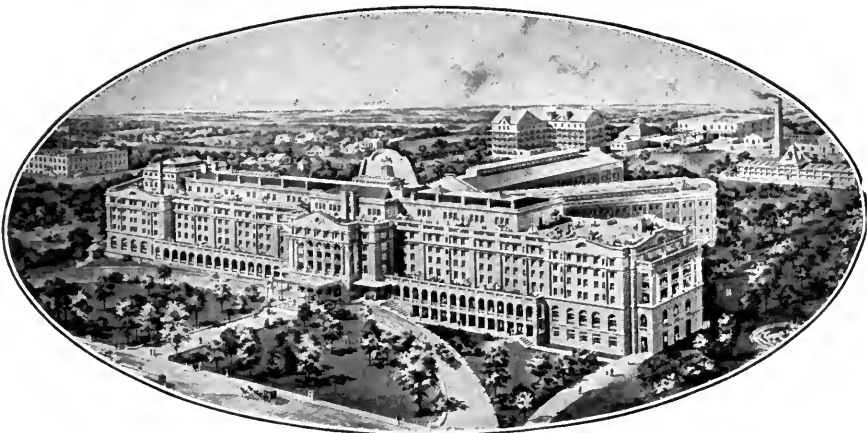
## SANTA RITA SPRINGS HOTEL

SANTA FÉ, ISLE OF PINES, W. I.

AMERICAN PLAN--Rate \$4.50 a Day and Up. Special Weekly Rates.

FIRST-CLASS CUISINE.

CATERS ESPECIALLY TO AMERICAN PATRONAGE.



THE BATTLE CREEK SANITARIUM AND HOSPITAL—Established 1866

## AN INVITATION TO PHYSICIANS

Physicians in good standing are cordially invited to visit the Battle Creek Sanitarium and Hospital at any time for observation and study, or for rest and treatment. ¶ Special clinics for visiting physicians are conducted in connection with the Hospital, Dispensary and various laboratories. ¶ Physicians in good standing are always welcome as guests, and accommodations for those who desire to make a prolonged stay are furnished at a moderate rate. No charge is made to physicians or dependent members of their families for regular medical examination or treatment. ¶ An illustrated booklet telling of the Origin, Purposes and Methods of the institution, a copy of the current "MEDICAL BULLETIN," and announcements of clinics, will be sent free upon request

## THE BATTLE CREEK SANITARIUM

ROOM 231, BATTLE CREEK, MICHIGAN



# CHALFONTE-HADDON HALL

## ATLANTIC CITY

*Combined in Ownership and Management*

The beautiful new Boardwalk Wing of Haddon Hall is now open. It connects the original Haddon Hall with the artistic pavilions, restful ocean decks, court garden and sea rooms of the 1920 addition.

*On the Beach and the Boardwalk  
American Plan. At your  
service every day of the  
year.*

*Attractive Souvenir  
Folder on Request*

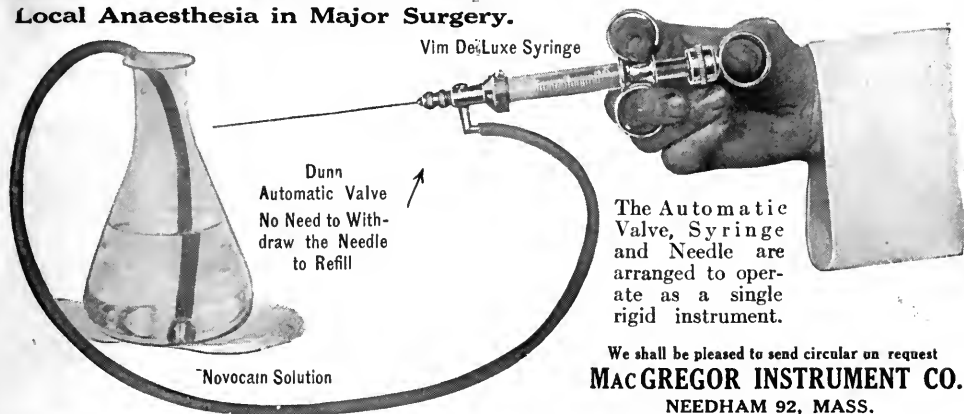
*On many occasions in the past Chalfonte-Haddon Hall  
was unable to accommodate all of its many friends*

The new Boardwalk Wing now makes possible the hospitable welcome of more than 1200 guests. While "old-fashioned" in its personal attention and service, Chalfonte-Haddon Hall has for more than fifty years kept abreast of the times in its modern facilities for pleasure, comfort and rest.

**LEEDS and LIPPINCOTT  
COMPANY**



**Dr. Louis Dunn's Automatic Outfit for  
Local Anaesthesia in Major Surgery.**



The Automatic Valve, Syringe and Needle are arranged to operate as a single rigid instrument.

We shall be pleased to send circular on request  
**MACGREGOR INSTRUMENT CO.**  
NEEDHAM 92, MASS.

**DR. BARNES  
SANITARIUM**  
STAMFORD, CONN.

A Private Sanitarium for Mental and Nervous Diseases, also  
Cases of General Invalidity. Cases of Alcoholism  
and Drug Addiction Accepted.

A modern institution of detached buildings situated in a  
beautiful park of fifty acres, commanding superb views of  
Long Island Sound and surrounding hill country. Com-  
pletely equipped for scientific treatment and special atten-  
tion needed in each individual case. Fifty minutes from  
New York City. Frequent train service. For terms and  
booklet address

F. H. BARNES, M.D., Med. Supt. Telephone 1867, Stamford

Fourth Edition

Revised and Enlarged

**MASSAGE**

MANUAL TREATMENT — REMEDIAL MOVEMENTS  
History, Mode of Application, and Effects; Indications  
and Contra-Indications

By **DOUGLAS GRAHAM, M.D.**

Consultant and Instructor in Massage, Boston, Mass. Member  
of the American Association for the Advancement of Science;  
of The American Medical Association; The Massachusetts  
Medical Society, etc.

75 Illustrations. 8vo. Cloth, \$6.00 net.

**J. B. LIPPINCOTT COMPANY**

PHILADELPHIA

LONDON: Since 1875

Since 1792

MONTREAL: Since 1897

16 John St. Adelphi E. Washington Square Unity Building

**When A Tonic Is Needed**

and the functions of the body are depressed and  
deficient, what restorative or reconstructive do  
you know of that will do more for the weak and  
debilitated than

**Gray's Glycerine Tonic Comp.?**

If you are not familiar with  
the therapeutic efficiency of  
Gray's Glycerine Tonic  
Comp., a trial in some case  
will show you the advan-  
tages of using a remedy that  
for over a third of a century  
has never failed in its re-  
sponsibility and good faith  
to those it has served.

What tonic when given to patients convalescent  
from *influenza, bronchitis, pneumonia, diph-  
theria, scarlet fever, or measles*, or from  
*surgical operations*, will so promptly stimulate  
the appetite, improve the digestion, increase the  
assimilation of food and thus restore vitality and  
strength, as Gray's Glycerine Tonic Comp.?

The answer to the foregoing is found in the thousands of medical  
men who use it regularly whenever a tonic is indicated. Their  
experience in countless cases has conclusively shown them that it  
has no superior in its field of use.

**The Purdue Frederick Co.**

135 Christopher Street, New York

Trademark **STORM** Trademark  
Registered Registered

**Binder and Abdominal Supporter**  
(Patented)



TRADE  
MARK  
REG.

TRADE  
MARK  
REG.

**For Men, Women and Children**  
For Ptois, Hernia, Pregnancy, Obesity,  
Relaxed Sacro-Iliac Articulations, Floating  
Kidney, High and Low Operations, etc.

Ask for "36-page illustrated folder. Mail orders  
filled at Philadelphia only—within 24 hours.

**KATHERINE L. STORM, M.D.**

Originator, Patentee, Owner and Maker  
1701 DIAMOND ST. PHILADELPHIA

*Let us make you feel "at home"  
in the city of robust health*

*Write for Booklet*

## **HOTEL MORTON**

Virginia Avenue  
**ATLANTIC CITY**

EZRA C. BELL

PAUL M. COPE

170 rooms with running water and  
telephone service, including 50  
suites with private bath. Auto bus  
at station. Garage, orchestra,  
white service.

500 feet from Boardwalk and  
Steel Pier.

**\$2.50**  
**Per Day**

*and upward*

is one reason for the rapidly  
growing popularity of the  
Hotel Martinique.

Another is the consistent  
economy of the entire estab-  
lishment. Here you may enjoy  
a Club Breakfast at 45c., con-  
sisting of Fruit or Cereal, Bacon  
and Egg, and Rolls and Coffee  
—Special Luncheon and Din-  
ners of superior quality are also  
served at the most moderate  
possible prices.

No location can be possibly  
more convenient than that of  
the Martinique. One block  
from the Pennsylvania Station  
(via enclosed subway)—Nine  
blocks from Grand Central—  
one block from the greatest  
and best Shops of the City—  
half a dozen blocks from the  
Opera and the leading Theatres  
—and directly connected with  
the Subway to any part of the  
City you wish to reach.

*The BEST without extravagance!*  
**Hotel**  
**Martinique**

*Affiliated with Hotel McAlpin*  
**Broadway-32<sup>nd</sup> to 33<sup>rd</sup> Sts.**  
NEW YORK

**A. E. Singleton, Manager.**





RD      Annals of surgery  
1  
A5  
v.77  
Biological  
& Medical  
Serials

PLEASE DO NOT REMOVE  
CARDS OR SLIPS FROM THIS POCKET

---

UNIVERSITY OF TORONTO LIBRARY

---

**STORAGE**

